A CRITIQUE OF THE PRACTICE AND METHODOLOGY OF OPERATIONAL RESEARCH

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ABSTRACT

The findings of a research project, conducted at Sheffield City Polytechnic between 1987 and 1992, are presented. The research was aimed at describing the work and methodology of operational research practitioners in the UK, and at promoting effectiveness in OR practice.

In-depth interviews were conducted with a small sample of OR practitioners, most of whom are employed as internal consultants. Interview findings were juxtaposed with the results of extensive literature study. Comparisons are made between contemporary OR practice and portrayals of OR in literature, and also with other types of consultancy within the management sciences. The development of a simple but powerful framework, for underpinning description of OR practice, is described.

In this thesis, operational research is portrayed as grounded in relationships with clients who are continually engaging in executive decision making. Problems are experienced as clients attempt to formulate theories about their environment, and proposals for action. OR practitioners aim to contribute insight to problem-handling processes. This is done principally by the provision of information, plus implications for action. OR practitoners also contribute information technology, and aim to enhance clients' intellectual processes by passing on problem-handling skills. Various types of technology are used as instruments in this process. OR practitioners utilise a 'structured approach' to situations. Extensive use is made of descriptive models; technology is also used for computation and to aid communication with clients. In the long term, OR work involves analysis of clients' problems, data management, development and maintenance of appropriate technology, and promotion of continuing consulting relationships.

The development of professional effectiveness in operational research is considered. A module within a postgraduate OR course was developed in order to engage OR consultants and students in critical reflection upon their practice and methodology.

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CONTENTS

Chapter 1

INTRODUCTION

Operational research is variously portrayed as a mathematical or scientific approach to problem solving or the achievement of efficiency, or as a collection of mathematical techniques. Whilst these portrayals convey valuable truths about operational research (OR), they fail to highlight a significant aspect of OR:

In 1984, the OR Society of Great Britain commissioned extensive research into the *practice* of OR. The Commission (ORS, 1986) commented that "practically all OR in practice is done on behalf of someone or some organisation other than the practitioner". In other words, OR is a *social activity*. Moreover, it is a *consultancy* activity. This is probably regarded as a truism by most people who consider themselves to be operational researchers, with only a small, academically-based minority earnestly believing that OR can be an individual, intellectual, experience. Nevertheless, OR methodology does not reflect this essentially social nature of OR practice.

In 1987, I began a research project, based at Sheffield City Polytechnic (SCP), in which I intended to *investigate* and *portray* OR as a consultancy activity. The ORS Commission found that OR practice is an essentially "in-house" activity (ORS, 1986) - i.e. OR practitioners are usually employed within the same organisations as their clients. The SCP research has covered OR practice in a variety of settings, but has been mainly concerned with *OR as an in-house activity*.

From the perspective whereby OR as viewed as a consultancy activity, the 'problem-solving' and 'mathematical' aspects of OR demand to be interpreted in their social context. A basic framework which has been developed during, and which underpins, this research can be summarised as follows:

> *OR involves acting as a consultant (of sorts), to a client (of sorts), to address or to help with a problem (of sorts), with the aid of models, techniques and technology (which are often mathematically based).*

It is my thesis that:

- OR practice can be *accurately described* with reference to this framework,
- that the adoption of this perspective can yield *significant insight* into the nature of the practice and its methodology,
- and that this insight (and also the framework itself) can help to make OR practice more *effective*, particularly through the development of *education and training* programmes.

This thesis contains a description of OR practice which is different from most 'traditional' portrayals of OR in a number of striking ways. The nature of the most significant findings is summarised below:

> OR is portrayed, not as a private puzzle-solving activity, but as a socially-complex occupation, grounded in *relationships* with other social actors.
>
> The problems with which OR practitioners are concerned are not intellectual curiosities, but are difficulties which arise in the *experience* of *clients*, who are continually engaged in executive *decision-making processes*.
>
> Rather than directly addressing and solving problems, OR practitioners are in the business of *helping* their clients

to deal with *their* problems. There are a variety of ways in which ORers may equip their clients by contributing to their problem-handling processes.

OR models and techniques are not the essence of OR *per se;* neither are they necessarily mapped onto problematic situations in order to produce solutions. In the context of problem helping, models and techniques are *instruments* which OR practitioners may use for a variety of purposes. In particular, models may be used to aid the consulting process, as well as the problem-handling process.

The models and techniques which are commonly used in contemporary OR practice are markedly different from the techniques that are described, or prescribed, in much OR literature and in many OR courses.

Although administered on a 'project' basis, OR practice does not involve a stream of unrelated problem helping experiences. Instead, projects have *technical, geographic, psychological and political connections* to other, past or present, projects.

In the long-term, OR is concerned with problem helping, but also with *engineering* situations in which problems are less likely to arise. Consequently, not all OR *projects* necessarily involve helping clients with 'new' problems.

My chief purpose in conducting this project has been to describe OR in a way which gives an *accurate* reflection of the, essentially social, nature of OR practice. As the summary in the preceding paragraphs illustrates, this involves *reinterpreting myths* about OR. It is hoped that, by adopting more *powerful* myths, the OR community can develop *methodologies* to equip practicing operational researchers for their socially-complex work. The intention of this research has been to promote more self-aware and, ultimately, more *effective* OR practice.

Before considering this project's aims in greater detail, I shall attempt to give tighter definition to some of the key terms that are used in this thesis. The need for such definition is illustrated below by an extract from an interview with an OR practitioner during the research project:

Q: "As far as you're concerned, what is OR?"

A: *(pause)*
"Well, I take the line that OR is what OR people do."
(leans back, looking smug)

Q: *(determinedly)*
"OK, what do you do then?"

A: *(looks out of window)*
"Well .. a lot of what we do isn't really OR."!

This low-key exchange involved a number of different uses of the term "OR". In this introductory chapter, I shall consider, often from a historical perspective, the various concepts to which the name OR is commonly attached. In particular, I shall explain what I mean by "OR practice" and "OR methodology". I shall then describe the aims of this research project.

1.1 OR Practice

As Conway (1984) states, "when the term Operational Research was first created in 1937 or 1938, it was to describe the work of a group of scientists and technologists who were endeavouring to make the newly developed radar system operational". It is widely considered that the *concept* of "operational research" has developed from the British Air Ministry's efforts to tackle the operational difficulties

associated with the development of radar for military purposes. This involved the establishment of a team of (civilian) scientists, whose specific tasks were to conduct *research into operational matters*, and to give advice to RAF officers in authority. The term "operational research" was coined to distinguish this work from other research concerned with the development of military equipment (Keys, 1991b).

Before long, there were operational research groups in several branches of the armed forces. Members of these groups were drawn from various scientific disciplines (though many were reputable physicists), and their work broadened into "the general method of science employed to study any problems which may be of importance to an executive" (Waddington, 1973). Their work involved much observation and collection and analysis of data, and attempts to understand the relationships between various factors in military operations, in order to advise military commanders.

At the end of world war II, the idea of using 'operational' researchers was transferred to the newly nationalised industries, whose complex operations presented fresh management problems. Small groups, dedicated to operational research, were set up within industrial research organisations. Many members of these groups had formerly been wartime operational researchers. Many groups practiced under the "operational research" banner, although some (such as the Field Investigations Group in the NCB) used other names.

As Keys (1991b) notes, "the first use of a label is clearly not necessarily equivalent with the introduction of the activity it is applied to". In other words, it is possible that 'operational research' - or "OR" - may have been *practiced* long before 1937 without being recognised by that name. In particular, Keys draws attention to the work of Charles Babbage in the UK, and F W Taylor in the US, as forerunners of OR: In the early nineteenth century, Babbage was concerned with how to organise factory work for greatest

economic benefit; Taylor was a machinist whose ideas about increasing industrial productivity and prosperity (at the beginning of this century) became known as "scientific management". As the scientific management movement took root in the US, Taylor and his colleagues operated as *consultants*, giving advice to managers within many different organisations.

Keys remarks that "the only essential change which occurred in the consultancies which included scientific management techniques in their portfolio when OR appeared was an increase in the sophistication of their techniques". There is, however, another major difference between the US management consulting and the kind of support provided by the early operational researchers:

> "The OR scientist certainly did not share the military manager's knowledge and experience of war; equally, the commander's knowledge of science was usually slight" (Beer, 1967).

The champions of scientific management gave advice *which stemmed from their experience*. By contrast, operational researchers offered their *skills, as scientists*, but claimed no particular experience of operations or their management. In OR, the difference in background, perspective and culture, between 'manager' and 'consultant', was greater. The use of research for direct operational benefit was "an outrageous idea" (Ackoff, 1979b). [Indeed, 'OR' may seem to be an oxymoron.] This idea has remained a feature of OR throughout its post-war development. Typically, those employed in OR consultancy groups are not, and never have been, managers themselves.

Undoubtedly, there have been changes in the practice of OR since its wartime 'beginnings'. By the 1950s, individual companies had their own OR groups, thus helping the groups to identify with local managers and their needs. Nevertheless, they continued to operate on a consultancy (i.e. non-executive) basis. OR is now practiced in a wide range of

organisations, in industry, business, defence, national and local government, and in the community.

The *nature* of the work done by OR groups has also changed. This is partly because of technological developments: the 1960s witnessed greater application of mathematics and modern statistical techniques, whilst the information technology revolution has had a profound effect on OR and many other aspects of organisational life since the 1970s. The effect of these developments was, initially, to extend ORers' repertoire of techniques. Bryant (1989) considers that an apparent failure of industrial OR to live up to its promises, coupled with a general loss of faith in the virtue of rational, controlling management, led to OR becoming "a narrow functional specialism directed in the main at relatively paltry tactical problems", and relying on "an arbitrary set of logico-mathematical techniques appropriate to solving the recurrent problems of large organisations".

The precise way in which OR has developed from its wartime practice need not concern us here. My purpose in this section has been to explain that the term "OR" originally corresponded to OR *practice*, whereby scientists acted as consultants to managers.

From the perspective of managers, and other people in organisations which have OR groups, "OR" may refer to the contribution that an OR group, *as a whole*, makes to the organisation. In this sense, we could talk of 'OR practice' as one might talk of (eg) a medical practice. However, individual members of OR groups are commonly referred to as "operational researchers", whilst promotional literature (such as job advertisements) offer the opportunity for an individual to *do* OR. This is not a trivial point. Tomlinson (1971) describes an attempt to distinguish between two types of OR group members:

> "the group was to be split up into two quite different kinds of people, those who were concerned with solving the problem and those who were responsible for the actual techniques to be used. .. a dismal failure, .. in operational research it is impossible to dissociate the technician from the problem-solver, .. everyone is an operational research worker"

Almost without exception, persons employed *in* OR practice are employed to *do* OR. It is therefore meaningful to talk about the work that is done by such persons as "OR practice". Members of OR groups undoubtedly each have a 'niche' within the group's overall practice. Most obviously, each group has a leader - or leaders - and group members all have their particular strengths and weaknesses in both technical and social aspects of the work. However, there is a sense in which all these people, with the possible exception of OR group managers, may be considered to be 'doing OR'.

I have dwelt on the origins of the term "operational research", but it is important to note that not **all of the** persons and groups who engage in this kind of activity actually *use* the same name. The title which is given to a group reflects the particular role that it has in its organisation, the intentions of its founder, and also the connotations that the name "OR" has in that organisation. Some groups have deliberately avoided the name because of some perceived negative connotations. Whilst operational research *per se* played a timely role in Britain's armed forces, it may be that other organisations, at other times, construe a need for a *slightly* different kind of skill or activity, and so may use another name.

The final point in the paragraph above is an important one, because it calls into question the (so far) cosy association between the *concept* "OR" and the *work* of individuals or groups. If organisational actors can do (or use) 'mathematics' or 'typing' if or whenever they feel the need, can 'OR' also be done or used in this way? If the answer is 'yes', then we are using "OR" to refer to a skill, or approach

to situations, which *transcends* the workaday practice of OR consultants. We may, then begin to talk about OR in abstract terms - as a *discipline* in its own right. The next section is dedicated to considering what it involves to view OR in these terms.

1.2 OR as a Discipline

For the first twenty years of OR practice in the UK, people were employed as full-time, dedicated, operational researchers without previously having a formal education in 'OR'. Not until the late 1950s did universities start to offer OR courses. Consequently, OR workers learnt their craft 'on-the-job', receiving training which was tailored to their organisation's particular circumstances. However, OR was already recognised to have "techniques of its own, suited to its own special material and problems" (Blackett, 1943), and began to be regarded *as a discipline*.

Despite being regarded as a discipline in its own right, OR has retained its *inter-disciplinary* nature - being commonly viewed as being at the interface of 'scientific research' and 'management problems'. Consequently, universities and colleges have never found a comfortable and obvious position for an 'OR' department within their organisational structure. OR is now taught, on first and further degree programmes and a variety of other courses, as a branch of mathematics or statistics, as an application of computing or computer systems engineering, or as a management/planning-related activity.

Many academic OR courses are designed to prepare students to work as dedicated OR consultants - i.e. to *practice* OR, in the traditional *consulting* sense. Other, shorter, courses are designed to give students 'awareness' of OR, or to teach them how to 'do a bit' of OR. In these cases, OR is not taught as a consulting activity, but as an *approach* to situations. The social context of these situations, in which the approach is

intended to be used, is often overlooked. Some of the people who teach OR on academic courses have several years experience of practicing OR behind them. Others have little or (in a few cases) no experience. There are, therefore, many ways in which the academic discipline 'OR' may be different from the practical consulting activity of the same name.

There is another 'arena' in which OR is propagated as a discipline: In 1948, the OR Club was formed, later to become the OR Society of Great Britain. Within the Society, and its many sub-groups, about 3000 people share ideas and argue their own points of view about various aspects of OR. Much of this activity is aimed at improving the practice (or teaching, or whatever) of individual members. However, since these members have quite diverse backgrounds, there is a sense in which the life of the OR Society encourages both its members and any interested onlookers to believe that there is 'something' called OR which would continue, in some shape or form, even in their absence. Moreover, the Society is actively involved in promoting OR as a career, and also provides a forum for collective public relations exercises by OR practitioners and groups. Similar organisations, carrying out similar activities, exist in many other countries.

1.3 OR Methodology

In the early days of OR, before it became a recognised academic discipline, practitioners learnt from their own experience, and from the experience of their colleagues. They learnt methods and techniques which could be applied to some, or all, situations. However, they also learnt that their work was *not* entirely *routine*; that there were different ways of working - perhaps different techniques or consulting approaches - which were appropriate to different situations. Most occupations involve learning processes of some kind, but it is particularly appropriate that operational researchers,

with their scientific backgrounds, should develop a *methodology* - a *science of method*.

We can use the term 'OR methodology' to describe a system of principles which *guide* and inform an *individual* OR worker in an ongoing process of method *choice*. However, the motivation for establishing OR as a discipline is the belief that there is sufficient commonality between workers' guiding principles that it is worthwhile sharing and debating these principles. It is, therefore, meaningful to talk about OR methodology which *belongs to the entire OR community*.

An individual ORer's methodology can be defined in terms of theories of action (Argyris and Schon, 1974), consisting of a vast number of 'advice statements' saying, 'in *this* kind of situation, if you want to achieve *such-and-such*, do *this* - given *these* assumptions'. It is important to recognise that practitioners may behave according to one theory, yet may believe and talk about a different theory. Clearly, OR practice is effected by theories *in use* (Argyris and Schon). It is also *affected* by espoused theories: As a practitioner pays conscious attention to particular ways of working, his repertoire of methods grows to reflect his intentions; as he reflects upon his behaviour, his espoused theories begin to reflect his theories in use. It is the degree of conscious, critical attention which is the key to learning to behave according to an espoused theory. For an individual OR worker, methodological development involves *reflection upon practice* and the *imagination* to develop theories which are better, in some sense.

Methodological development which spans the community of OR workers depends upon the interaction of these workers, and of their espoused theories of action. Through the combination of experience and reflection, they may be able to assemble a *general* OR methodology - a theory of 'how OR should be done'. A collective OR methodology will be more prescriptive in

nature, because it will not necessarily coincide with individual practitioners' own views.

The development of a jointly owned 'science' of OR practice and methods may be developed with the assistance of dedicated scientists, whose programmes of research would require the collaboration of OR groups and practitioners. This 'science' would be concerned, not merely with making 'objective' observations of OR practice, but with discovering the meaning that ORers attribute to what is going on, and to what they are doing. In other words, their theories of action would be studied, as well as just their behaviour.

The obvious base for these scientists of OR is in the academic OR departments which are committed to teaching OR. Where this practice is adopted, universities and colleges can ensure that they are properly preparing students for their future adventures in OR practice. Regrettably, this practice is rare, particularly in the UK. This does not, however, prevent a collective view of the nature of OR from being formed; rather, this view is established through myth and story-telling instead of through scientific research.

Since the mid-1970s, it often been acknowledged that, as Pidd (1985) remarked, "there is a distinct shortage of theory which gives appropriate guidance for actually doing OR". Bevan (1976) considered that the OR community's problem was its lack of a sufficiently critical attitude. It has subsequently been argued (Bryant, 1988, Jones, 1988a) that individual practitioners' failure to reflect upon their own practice, and to attempt to describe it, is a major stumbling block to methodological development.

On other occasions, ORers argued that a comprehensive methodology *had* been developed, but that this was now out of date, either because OR practice had changed, or because the community had achieved a new level of consciousness, from

which it could identify shortcomings in the old theories. In 1977, the OR Society organised a seminar entitled "The King Is Dead: Long Live The King?" Similarly, Dando and Bennett (1981) suggested that OR might be experiencing a "Kuhnian crisis". This term denotes a point, during the development of a science, at which the established paradigm - or system of theories - struggles to retain its credibility, and eventually becomes superseded by a new paradigm which seems more credible. Another period of 'normal science' follows.

From this perspective, OR's dominant paradigm determined that OR was, and should be practiced according to some variation on the following stepwise procedure:

1. Work out what the problem is;
2. Construct a mathematical model of the situation;
3. Experiment with the model, to find the best way of handling the situation;
4. Try this out, and monitor the results.

The origins of this idea are betrayed by part 3., in which the ORer supposedly conducts (scientific) experiments. This process describes (or prescribes) a way in which the scientists who became the first ORers could have utilised their scientific skills in their new practice.

In 1984, Conway remarked that, during the 1970s and 1980s,

> "there have been a considerable number of contributions to the methodology and practice of Operational Research. Most of them, however, do not look at the process overall but instead concentrate on one particular aspect of the process" (Conway, 1984).

Examples of this work include the following: reviews of approaches to part 1. (eg Pidd and Woolley, 1980); reviews of approaches to part 4. (eg Schultz and Slevin, 1975, Pidd, 1988); consideration of the links between the stages (White, 1975); and reviews of the processes by which part 1. is reached (eg Conway, 1984).

An interesting feature of the work cited above is that the few empirical studies, such as those by Conway, and Woolley and Pidd, have suggested that many critical aspects of practicing OR cannot adequately be described or debated within the stepwise science-based framework. In particular, the consultancy nature of OR practice is completely disguised. Given that consultancy was an *essential* feature of early OR practice, it seems that Dando and Bennett may have been optimistic when they suggested that OR had already reached a Kuhnian crisis. It might be more accurate to say that OR has never had a period of 'normal science', and that its methodology is still at a primitive stage of development.

1.4 OR Literature

In my discussion of OR methodology, I have made numerous references to *published* research. Within two years of the formation of the OR Club, the first issue of its journal - OR Quarterly - was published. Although the journal - now called the Journal of the OR Society - has always been keen to publish practical case studies, it has mainly become an outlet for academic work. This includes some case studies and results of empirical research, but as Rivett (1981) so abruptly put it,

> "Those who know OR as it is practiced will comprehend that the Journal has virtually no relationship with what is happening up and down the country".

The 'Kuhnian crisis' debate was based largely on an assessment of OR as portrayed in literature. The following, enlightening, remarks were made by John Lawrence, a former editor of the Journal:

> "it [the debate] went on in the sixties but I let little of it appear in the ORQ .. The Journal reflects the nature of the profession, but it is also an organic part of the profession and has an influence on that nature" (Lawrence, 1982).

In other words, not only can the literature not be relied upon to reflect the nature of OR practice, but it cannot be relied upon to reflect OR methodology either. The content of the literature also depends upon the policies and whims of the authors and editorial staff.

However, as Lawrence points out, OR's literature does have an influence upon other aspects of the "profession". It provides the principal medium through which theories of action are expressed, and through which methodological debate is pursued. On both sides of the Atlantic, a 'new breed' of journals are now published (notably OR Insight, Interfaces and Omega) in a conscious attempt to retain an authentic expression of OR practice and methodology through literary artefacts.

Another literary outlet for OR methodology is through books, although the OR community has generated surprisingly few of these in over fifty years of practice. Most OR books are, in fact, university textbooks. One of the earliest of these, by Churchman, Ackoff and Arnoff (1957), is now regarded as a 'classic', and most subsequent textbooks have a similar structure and content. It is worth noting that this book was based on academic OR courses in the US, where OR was adopted as a relatively narrow specialism amongst other management sciences. In this way, the pattern which so many UK writings have followed was set long before UK universities had established research programmes into OR practice.

Recent years have witnessed a sudden surge of OR books onto the market. Many of these, such as those edited by Tomlinson and Kiss (1984), Jackson and Keys (1987) and Rosenhead (1989a), are intended to portray *alternatives* to 'classical' OR methodology. Consequently, there is still a dearth of literature which gives students of OR a thoroughly researched, and balanced view of how OR is practiced (in the UK).

It is likely that more authentic characterisations of contemporary OR are contained in intra-organisational literature such as internal reports and bulletins. This type of literature gives a local picture of how OR practice is seen (or how ORers wish their practice to be seen) by those who are clients of OR, or who administer OR. It is not, however, likely to describe OR workers' experience or their methodology.

1.5 OR Culture

In summary, there are several components to the OR 'profession', each of which lay some claim to the "OR" label. These are OR practice (individual and corporate), OR methodology (individual and community), the 'OR' approach to situations and the academic discipline 'OR', plus various literary artefacts. These components are set against a the background of a general OR culture - i.e. the collective wisdom, experience, attitudes and habits of members of the OR community. Ideas about the nature and method of OR may be dissipated from one of the components to the others either directly, through the various channels described above, or osmotically, as vague impressions that are part of the OR culture.

Members of the OR community also belong to other social groupings, and are parts of their cultures also. Consequently, there is a certain amount of cross-fertilization of ideas. In particular, individuals and groups may deliberately develop their "OR" methodologies by drawing on the methodologies from other (related, or apparently unrelated) activities.

The OR Profession: Showing how ideas are absorbed into the various components of the profession

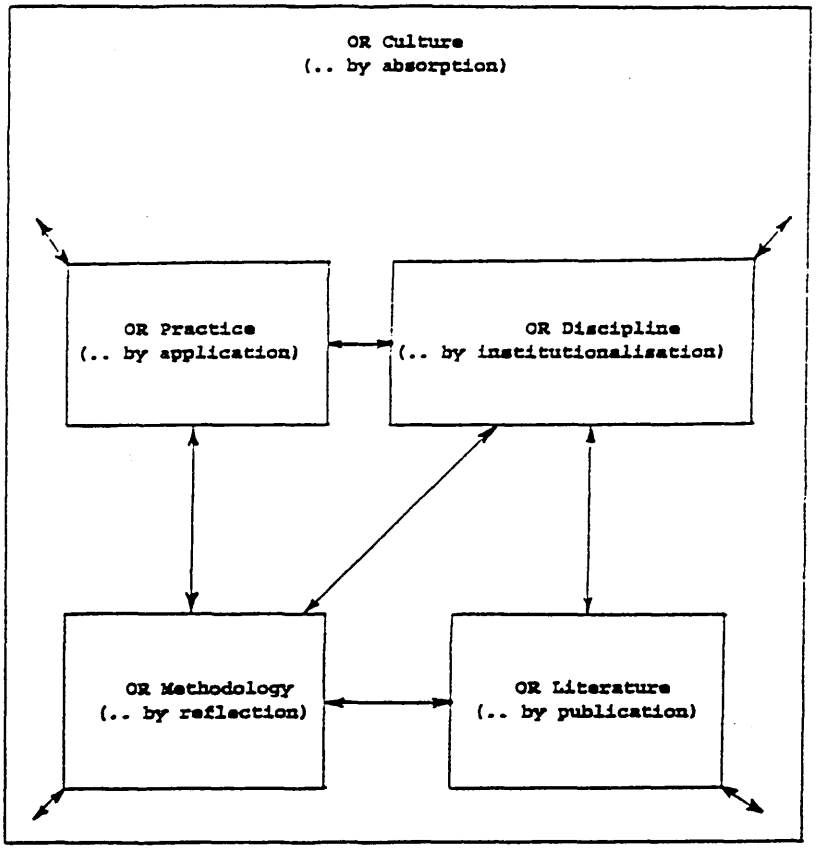


Figure 1

The various components of the OR profession are shown in figure 1, above. To paraphrase Lawrence, each component is an organic part of the profession, capable of purposefully generating ideas about OR, and of re-shaping ideas generated by other components. Each component may, on occasions, be referred to simply as "OR". It is, therefore, important that statements about OR should be interpreted very carefully. As an example, let us return to the interview with the operational research practitioner:

Q: "As far as you're concerned, what is OR?"
[what meaning do you attribute to the term 'OR'?]

A: "Well, I take the line that OR is what OR people do."
[the only reasonable use of the term "OR" is in reference to OR practice]

Q: "OK, what do you do then?"
[tell me about OR practice]

A: "Well, a lot of what we do isn't really OR."
[a lot of OR practice is quite different from OR as portrayed in the textbooks]

The addition of the parts in brackets confirm that this was actually a perfectly sensible conversation. However, the ease with which the 'objective' listener may construe the answers as plain nonsense demonstrate that OR's verbal artefacts are a lexical minefield.

1.6 Aims of This Research

My own position within the OR community is that of an academically-based researcher. In short, I have attempted to carry out scientific research into the nature of OR practice and methodology in the UK. In this section, I shall describe my aims in more detail.

In section 1.3, I explained that I consider scientific knowledge of OR practice to be at a rather primitive stage in its development. The OR community, as a whole, does not appear to have made a concerted effort to understand its own subject. Those actively engaged in doing OR have, by and large, concentrated on *doing* OR, whilst academics have been left to contemplate what *might* be true. Moreover, when OR

practice *has* been studied, attention has been limited to certain *aspects* of OR, whilst the *overall* nature of the activity has remained untouched.

OR Practice

My aims in this research have been dominated by two overwhelming concerns, with regard to OR practice: Firstly, I have sought to investigate and describe OR practice in such a way that *individual practitioners* are 'centre stage'. This is a different approach to that adopted by Keys (1991a), for example. My reasons for this choice are that I consider individual actors to be the basic elements of social life, and also to be the primary (perhaps the only) mediators in the process of methodological development. Consequently, if research into OR practice is to have any effect on practice, it must be possible to make its findings 'actionable' or, in some other way, accessible by OR practitioners.

Secondly, I have sought to investigate and describe OR practice *as a whole*. By this, I mean that I have been concerned with OR practitioners' working lives as holistic experiences. It is, of course, necessary to examine a breadth of OR work in different settings, if *general* statements about the nature of OR are to be made. However, in this particular research project, I have considered the holistic *quality of singular statements*, rather than the *quantity* of them, to be my priority. By investigating individual ORers' practice, I have hoped to be able to make a tentative contribution to the OR community's understanding of *its* (collective) practice

During the early part of the research, the term 'consultancy practice' was used to describe the research topic. This was to emphasise the consultancy nature which has always been an essential aspect of OR practice - i.e. to reflect that "all or most OR is done for, or on behalf of, someone else" (ORS, 1986), other than the OR practitioner. Although OR is an inherently social activity, the social aspects of OR practice

have received received little attention in OR literature. I have hoped to offer a *fresh perspective* on OR practice by describing it as a consultancy activity. The nature of the work done by people who are not consultants, but who use 'an OR approach' to their own situations has *not* been investigated during this research.

There are two other early research aims which have received little attention. It was originally my intention to *compare* OR work in various different settings, and also to compare OR with the practice of other 'management service' activities, such as management consultancy, organisation development, organisation and methods, computer software consultancy etc. Both of these types of comparison require extensive fieldwork. As I shall explain in the following two chapters, these aims have largely been sacrificed in an attempt to fully describe *'normative'* OR. In other words, in the trade-off between in-depth analysis and sophisticated inference on the one hand, and large-scale but superficial comparisons on the other, I have chosen the former approach in this research. This is not because I think it is necessarily a 'better' research method, in some absolute sense, but because it seems *more appropriate to the present degree of understanding of OR practice.* However, I have made extensive use of ideas and frameworks from a variety of management sciences in my attempt to describe OR.

OR Methodology

The research has not been limited to investigating the workaday activities of OR practitioners. This sort of approach would be adequate if the ultimate objective was merely to warn graduate students about their prospective working conditions. If research findings are to include incisive and actionable statements to be aimed at practicing operational researchers, they must *make sense in the context of those practitioners' methodology.* With this in mind, I have attempted to discover ORers' methodologies - i.e. the

systems of principles which guide and inform their practice - as well as to discover the practice itself.

As with OR practice, by investigating individual ORers' methodologies, I am making a tentative contribution to the OR community's *corporate* methodology - i.e the science of OR practice which transcends the practice and methodology of individual ORers. In attempting to contribute to this science, I shall necessarily examine contemporary research work, and other general statements that are being made about contemporary OR. I have aimed to relate my own research findings to these wider general statements. Public domain literature, such as papers published in journals, has been a major source of data for this part of the study.

A description of OR practice and methodology is necessarily underpinned by a conceptual framework. It is possible to make *some* interesting statements about OR with respect to existing frameworks. However, this does constrain the originality of the research findings. I have, therefore, attempted to develop a framework, for describing OR practice, which is sufficiently simple and robust to be applied to a variety of approaches within OR, but which is sophisticated enough to underpin novel and critical debate. The development of this framework has been an integral part of the research process. I have attempted to construct a framework from everyday language and concepts; my intention here has been to make a contribution to methodological development which is *accessible* by a wide range of OR workers. I have explicitly considered the suitability of frameworks that have been developed previously.

One specific aspect of OR methodology which received attention in my original research proposal was consideration of the meaning of "effectiveness" in OR practice, and the identification of the prerequisites for effective OR. This subject is addressed in chapter 11 of this thesis. In summary, as the research progressed, I came to believe that

perhaps the best way of improving the effectiveness of OR is *promote learning by OR practitioners*. In general, this can be done by encouraging ORers to engage in critical reflection upon their work, by offering scientific knowledge of the subject, along with some untried ideas, to help to focus this reflection.

The following chapter describes my research methodology; in it, I shall explain *how* I have carried out the research whose aims are outlined above, and *why* I have done it in this particular way.

Chapter 2

RESEARCH METHODOLOGY

This chapter covers a wide range of issues which can be considered to be part of the methodology used in this research. The first section of the chapter gives an overview of the research *methods* that I have chosen to use, and the reasons behind these *choices*.

The second section (parts 2.2.1 to 2.2.3) explains my *assumptions*, concerning the nature of truth, knowledge and science, which lie behind, and which undergird, this research project. The following two sections (2.3 and 2.4) are concerned with the *implications* that these epistemological considerations have for *social science* in general, and for this study in particular.

Section 2.5 describes the conduct of a pilot study, and the role that this study had in developing the research methodology. The final section is concerned with practical aspects of designing and conducting a survey.

2.1 Choice of Research Methods

In this section, I shall outline the methods that I have used to study OR practice and methodology, and shall give an overview of the research process. Clearly, any investigation of OR *practice* (as distinct from literary artefacts etc.) must be based on some sort of 'fieldwork'. I shall consider this approach first.

2.1.1 Fieldwork

I decided that fieldwork should be carried out using *in-depth, unstructured interviews with OR practitioners*. There are a number of reasons for this:

1. As I was interested in investigating practitioners' working lives *as wholes*, I needed a method by which these experiences could be compressed into a few days, or even a few hours. Observations would only have provided 'snap-shots' of OR practice, rather than a 'full-length feature film. This practical consideration limited my repertoire to interviews (of various kinds) and questionnaires.

2. In any case, as Popper (1963, 1968) and Whewell (1840, 1847) have argued, observation is both selective and theory-ridden; an observer sees what he expects to see, and interprets raw sensual experience in a way that makes 'sense' to him. Observations are appropriate when the observer is confident that he properly understands what he is observing.

3. My research aims extended beyond finding out how ORers spend their days at work; I have also aimed to *interpret* their work, in order to understand how their days' work constitutes a vibrant consultancy practice. Snap-shots taken by observation would be extremely difficult to interpret, and would be potentially quite uninteresting. As one practitioner, who was interviewed during the research, said:

   > "what people would see if they came into our office would be pretty much the same as they'd see in any other office - they'd see people using computers and drinking cups of tea".

4. Operational researchers are the obvious choice of subjects in a study of OR practice, but this assumption benefits from more consideration. Other social actors who are involved in OR work (such as 'clients' of OR) could also

interpret ORers' activities. However, this approach entails difficult decisions about how research subjects should be selected; for instance, should these people be recommended by OR practitioners, or approached by some other means? (Polding and Lockett, 1982, Wedley and Ferrie, 1978). I am particularly concerned with ORers' *rationales*, which can only be discovered by studying *them*. It is possible that a broader perspective of OR could be obtained by supplementing study of OR practitioners with a survey of clients and other persons but it has not proved feasible to extend this particular project to include this sort of survey.

5. Within the practical constraint in 1., above, lengthy unstructured interviews are more suitable than structured interviews or questionnaires where a researcher is interested in eliciting the *meanings* that the research subjects attribute to situations. By using unstructured interviews, I have given OR practitioners opportunities to *define for themselves* the salient aspects of their practice and methodology.

A 'pilot study' was carried out between April and August 1987, principally to raise issues that might need to be addressed before a more formal survey was designed. The pilot study is described in detail in section 2.5. At the same time as this study was being conducted and analysed, I undertook to consider epistemological and methodological issues relevant to the study of OR practice using in-depth interviews. I also considered how a (reasonably) representative sample of OR practitioners could be obtained. These issues are discussed in sections 2.4, 2.6, and 3.2. The main body of fieldwork was done between November 1988 and April 1989.

In order to gain a broader appreciation of OR practice, and of communal OR methodology and culture, I joined the OR Society. I have been able to enjoy much informal interaction with OR practitioners and other researchers by attending and

organising meetings and conferences. [See Appendix A for details of this involvement, and for the chronological details of the research process.]

2.1.2 Literature study

Although the science of OR practice seems to be quite primitive, there is a considerable amount of literature in which OR practice is described, or prescribed, in some way. Early in 1987, I began to explore the availability of suitable frameworks for underpinning description of OR practice. These frameworks include those that have traditionally been used for this purpose, and also those that have been used in other disciplines. Potential frameworks are summarised in chapter 3, and more thoroughly reviewed in chapter 10. In view of my desire to study OR as a social activity, those disciplines that seemed most likely to offer suitable frameworks included organisation theory, organisation development, systems science and various types of consultancy. The branch of OR known as 'soft' OR appears to have relatively well-developed theories of practice (although some would disagree with this assessment, eg Keys, 1989a). I examined much soft OR literature, and considered the suitability of its language for OR in general.

OR literature contains some papers which explicitly address OR consultancy practice, but many more books, papers, case studies and articles which are principally concerned with mathematical techniques which are, or perhaps could be, used in OR, and which refer only in passing to the social aspects of OR. Nevertheless, this literature is a valuable source of data, because it carries *public statements* about a subject called "operational research". My research project should culminate with publishable statements about OR. It is, therefore, essential that I should be able to juxtapose my findings with previously published statements.

I have surveyed the Journal of the OR Society (formerly OR Quarterly) since 1965, as it is the major UK publication bearing the name "OR". In presenting my findings, I shall make extensive reference to papers published in this journal. Other publications which have proved particularly useful include the journals Omega, Management Science, Interfaces and OR Insight. There have, until recently, been very few books dealing with OR practice, but I shall refer to these also, where appropriate. The majority of my literature sources have originated in the UK, although I have utilised literature from elsewhere (particularly the US) where this appears to have an influence on OR methodology in the UK.

2.2 The Nature of Scientific Research

I stated in the opening chapter that my aim has been to conduct *scientific* research into OR practice. Moreover, I take it as axiomatic that OR is a *social* activity, and I have attempted to study and describe it in a way that reflects this social nature. In other words, I consider myself to be involved in *social science*.

In this section, I shall elaborate on the meaning of this, by explaining my assumptions about the nature of truth, knowledge and science. These assumptions are rooted in Christian faith, and could be described as 'Christian supernaturalist' views. I shall discuss my assumptions at some length, and there are various reasons for this. The main reason is that this written discussion represents lengthy thought processes through which I have struggled to establish whether or not a Christian supernaturalist social science is actually possible and, if it is possible, what it should be like. My main purpose, here, is to argue that Christianity *does* offer *a* stance from which a social science may legitimately be developed.

A secondary reason for this discussion is that these assumptions have some implications for the practice of social science. I shall indicate, later in this chapter, how my research methods were affected by the stance I have adopted. I hope to show that my methods and judgments are consistent with the stance that I have adopted. I acknowledge that other researchers, within the OR community or beyond, and readers of this thesis, may adopt many different stances. If other people experience any difficulties in understanding my methods and judgments, I hope that I have enabled them to trace my arguments to particular assumptions about the way the world is. In the final chapter of the thesis, I shall offer some reflections on the ways in which alternative assumptions might have affected the outcome of the research.

2.2.1 A Christian view of truth

There has, historically, been a strong relationship between science and Christianity. This is because Christian doctrine asserts that God is supremely *purposeful, orderly and intelligent*, and that he created, and maintains the world. It follows that the world itself is orderly, in some sense. Consequently, scientific theories, 'laws', or general statements, may be regarded as descriptions of "habits of God" (Forster and Marston, 1989). Facts are of prime importance in the search for experience of truth, because they are 'pegs' on which God has chosen to hang truth.

This belief inspired many scientists, such as Galileo, Kepler, Bacon, and Boyle, from the sixteenth century onwards. Indeed, it is interesting to note that some contemporary scientists (eg. Fred Hoyle) have recognised that the world is apparently *purposive*, and that this implies the existence of a purposeful mind (Davies, 1992, Forster, 1991).

Science and religious faith were thought to be compatible. For instance, Galileo (1615) said that "the Holy Bible and the

phenomena of nature proceed alike from the divine Word" (here, the "Word" is *logos* - the revelation and agent of God). Science and faith have often been separated into two provinces of thought. Francis Bacon (1734) developed the idea of "two books" - containing theology (knowledge about God), and science (knowledge about nature).

However, the distinction between the 'two books' has degenerated into what Payne (1990) calls "the terrible schism within the heart of man". The schism exists partly because believers have insulated matters of faith from the attention of inquiring minds. It is also partly because a popular view of science has developed which assumes that religious beliefs and experience, feelings, values and choice have nothing to do with the proper pursuit of knowledge, which is science i.e. that truth is vested *entirely* in facts.

Consider, for instance, the conventional use of the notions of 'truth' and 'facts' in courtroom proceedings: oaths are pledged to "tell the whole truth", and subsequent inquiry focusses on establishing 'the facts' of the matter. Truth and facts are assumed to be equivalent. This assumption is formalised in 'correspondence theories' of truth which basically state that a theory is true if it conforms to the facts.

In contrast, Christian doctrine points towards a more holistic understanding of truth and knowledge. In Payne's rhetoric,

> "Christian epistemology is unique in that our way of knowing is rooted in Christ's incarnational Presence. .. How can we know truth? .. We know Ultimate Reality, not by theological ideas about it, .. but by union with it".

Her argument is not that intellectual study cannot discover truth about the world, but that it is an incomplete approach to understanding.

Experience tells us that factual statements can be made (in a courtroom, for instance) which convey *un*truth, and that the truth (or otherwise) of a statement lies partly in its *interpretation* - in the *sense* of the message. Facts, and scientific theories, are not the only tools for representing and expressing truth. For instance, Plato wrote of the use of *myths*, whose message is that "this or something like it is true" (Plato, in *Phaedo*).

> "The purpose of myth", Forsyth (1952) explains, "is to express in an imaginative or figurative way, truths that are difficult or even impossible to state in any precise of definite terms."

A balanced Christian view of truth, then, is that much truth is vested in facts, but not all truth. Scientific theories provide a *useful focus for social debate* about truth, in a way that many other kinds of knowledge cannot, since they are based on facts. Other social institutions can serve the same purposes, but are often less reliable. Truth, itself, is *transcendent*, and independent of scientific theories, and all other social institutions.

2.2.2 Scientific knowledge

Science is traditionally concerned with establishing *objective* knowledge; Popper (1972) explicitly stated this as the aim of science. Objective knowledge is, literally, knowledge without a knower - knowledge which exists independently of a knowing subject. Since knowledge must be possessed by somebody, scientists' aim is to *'objectify'* knowledge through its joint acceptance by society as a whole. Thus 'scientific' knowledge becomes part of what Popper calls "World 3", established as an institution which is fairly robust to changes in the population.

The social dimension of science is critical to its claim to objectivity. If this is ignored, then the legacy of so-called science is not objective knowledge, but merely knowledge

"whose vantage point may be inadequately triangulated" (Bryant, 1989). For knowledge to be objectified, science must be *open*. By this, I mean that scientists must clearly articulate and express their "conjectures" about the world, and subject them to testing by the rest of society. This idea is characteristic of Popper's 'falsification' view of science (Popper, 1963).

However, it is a truism that *scientific study is done by interested* people. Although some early discoveries in physics may have been naive, in the sense of being concerned with knowledge about the world for its own sake, the motivation for the development of a scientific discipline is often the desire to *change* the world. People attempt to *understand* the world, or part of it, so that they can influence or *control* it. Lyon (1975) traces the roots of sociology back to the need to contend with the social implications of the industrial revolution. My interest in studying the practice of operational research developed from an introduction to the subject within a university degree course, followed by three months' experience as an OR analyst in the retail business. I did not enjoy the latter experience, and I wanted to find out what how OR was practiced elsewhere. I wanted to *make sense* of my own experience. However, I also sensed an opportunity to *influence* the development of the profession.

There has been much debate about the processes by which scientific theories are developed and exchanged, and about the relationship between theories and truth. In general, science is recognised as a critical and creative process by which

(i) theories ("*general statements*" - Chalmers, 1982) are developed from the experience of a collection of facts ("singular statements"),

and subsequently

(ii) theories 'frame' the experience of facts. Following Popper (1968), I regard observation statements as "interpretations of the facts .. in the light of theories".

General statements describe "transfactual tendencies" (Chalmers, 1982), and are thought to be relevant to experiences other than those on which they were based. I consider this dialectic to be a reasonable description of both natural and social science. In the case of social science, the place of "facts", in (i) above, is taken by the singular experiences of a researcher. Social science's special problems of interpretation may be included in (ii), above.

The PhD and scientific progress

The CNAA (Council for National Academic Awards) regulations for research degrees state that a Doctorate of Philosophy should be awarded for a 'critical investigation' resulting in "an independent and original contribution to knowledge" (CNAA, 1989). The magnitude of this contribution is undefined, but is suggested by what is expected to be achievable within given time constraints (Ziman, 1987). It is not clear what "independent" means in this context.

The processes by which scientific progress is made are often described in a piecemeal fashion (Chalmers, 1982). It is often taken for granted that each individual research project must comprise a thorough and conclusive testing of a hypothesis against (factual) experience. However, I have defined science as an open social endeavour. From this perspective, it is unclear whether such endeavour should *follow* an individual research project, or be *included* within it, or whether the examination process embodies the necessary societal criticism. It would certainly seem that the completion of a doctoral thesis and subsequent award neither signify nor guarantee the acceptance of a researcher's

findings by a wider scientific community, let alone by society at large.

I consider that a contribution to knowledge can be made through substantial involvement in *some or all* of the (social) activities of science, such as the articulation of ideas and hypotheses, critical study and classification of factual experience, and the testing of hypotheses against experience. However, since the award of a PhD should perhaps acknowledge the successful completion of a period of research training, as well as the completion of a thesis, i.e. acknowledging the *process* of scholarship as well as the *product* of scholarship (Young, 1987, Hay, 1987), it is appropriate that a PhD thesis should indicate a degree of competence in *all* aspects of the process.

In the opening chapter, I explained that I believe the 'science' of OR to be at a primitive stage, and that I have chosen to do an in-depth analysis of the nature of OR practice and methodology, rather than to conduct a large-scale survey at a more superficial level. As a consequence of this choice, the contribution to knowledge that is made by this research will be mainly in terms of the generation and articulation of plausible hypotheses about OR which are grounded in thorough empirical study, plus critical examination and classification of previous and contemporary general statements about OR.

2.2.3 Social science and metaphysics

> "Without metaphysics, social science is impossible ... Society cannot be seen, touched, smelled, or in any way directly known by the senses even though the social does give physical evidence of itself through patterns of behaviour and language" (Puhek, 1982).

Any attempt at social science is based on particular assumptions about social reality. In a Christian social science, the metaphysical nature of certain assumptions is made explicit, as follows:

(i) In Christian doctrine, human beings are objectively real, and are significant as whole individuals. Consequently, social science must focus on 'the whole person'. Even if a specific part of a person's life is of particular interest, this part must not be studied in isolation from the rest.

(ii) Relationships between individuals are also objectively real, as are organisations and societies, even though they are more difficult to comprehend and describe in terms of physical, factual existence. Organisations (etc.) are real as they are comprised of whole individuals, and the relationships between them.

(iii) "The principle impact of an unexamined metaphysics involves the issue of values ... value is fundamentally metaphysical ... it is known to be metaphysical. .. Social scientists throw themselves into innumerable mental gyrations in order to maintain the fiction that they are not making or pursuing value judgments" (Puhek, 1982).

Notions such as 'functionalism', 'socialisation', 'deviance', 'democracy', and even 'market' and 'economy' are used in social science to import metaphysical value judgments about the way society is, or should be (Andreski, 1972, Puhek, 1982). From a Christian perspective, *ultimate value* is explicitly recognised, i.e. moral goodness - which has its roots in the personhood of God - and moral wrongness. It is recognised that people have the capacity to do both right and wrong.

However, Christian values, and their application in complex social environments, are not neatly catalogued. Certain basic principles - such as love and service - can be clearly discerned in the bible, and represent *ideal* behaviour within any social structure. An ideal social structure is less easily discerned, although certain metaphors - for instance, a family, a body, a tree - are used to describe ideal organisations. These are, what Mannheim (1948) would call, "utopian ideologies".

2.2.4 Implications for this research

In this section, I shall outline the main implications, for this research project, of adopting the perspectives set out in sections 2.2.1-2.2.3, above.

On facts, science and truth:

The data that I have collected, through fieldwork and through literature study, includes facts - categorical statements about events etc. - but also includes stories, opinions, feelings, insinuations, and generally less easily articulated statements. The significance of this data, and any truth in it, lies in the *meanings* which statements or behaviour have for the interviewees/authors, rather than in their factual content (see section 2.1.1). There is a tendency for researchers to rely on factual data (Carter, 1987, ORS, 1986, are examples of this type of work in the OR field). I consider my use of messy, qualitative, data to be as scientific as other, more traditional, empirical studies.

A practical consequence of using this kind of data is that *aggregation* of data from individual interviewees (for instance) is difficult. Factual data is more amenable to measurement and quantification. A corollary of this is that it is difficult to describe research findings in a way that guarantees proportional *representation* of the *sample* data. Inference about a *population* is, therefore, also difficult. With these provisos, I have subjected the data to considerable criticism. The outcome of this criticism is, however, rarely a factual statement or statistical measure. Nevertheless, I have tried (as would be the case with literary criticism, for instance) to address the data, and to present my findings, in a structured way, rather than by telling stories about OR practice or writing a biography of an OR practitioner, for instance.

The process by which these ideas become (more) accepted abroad the OR community must continue around and beyond this project. This entails social interaction, publication of project findings in a suitably accessible form, and a commitment from within the community to utilise this research. (I shall indicate, in the concluding chapter, how this might be done.) Only through this kind of 'objectification' can any output from this research be properly considered as 'scientific' knowledge. Whether or not there is *truth* in the research findings is another matter, though I hope that through my choices of research method, and my execution of the project, I am able to make some statements which are reasonable approximations to truth.

On social life:

The decision to focus upon the work of individual OR practitioners (section 1.6) was influenced by the assumption that individuals are the basic elements of social life. OR practitioners are usually employed, as such, for around forty hours per week, and have a specified role to play during that period. Nevertheless, I consider their whole-life experience to be indivisible. In trying to find out about their OR practice, I consider it important to become acquainted with, and to understand, them as people.

The philosophical tradition of phenomenology, and the tradition of 'interpretive' sociology, and the "action" perspective of organisations (Silverman, 1970) are relevant to this understanding of the nature of social life. However, there is also a need to take account of continuity and structure in organisational life. Tranfield (1983) suggests that the adoption of a hermeneutic perspective can help to reconcile these types of concerns. These approaches to fieldwork are considered in the next section.

On values:

The basic implication of my perspective on values is that there are morally right and wrong patterns of behaviour in OR practice, and also within the environment of OR practice. I have indicated that I look to Christian doctrine and tradition for the identification of values. However, I have noted that it may not always be straightforward to say 'this behaviour is right' or '.. wrong', and I am aware that many interested readers and researchers, and OR practitioners themselves, may adopt different perspectives. Consequently, I have deliberately chosen to pay attention to the areas of OR practice where the impact of values are most apparent, but not to state value judgments explicitly.

Within this thesis, I shall consider ORers' relationships with clients (in terms of motivations, theory and practice), and also their relationships with other people encountered in OR practice. I shall consider ORers' aims in their work, and their motivations for working in OR. In particular, the notion - common in OR - of 'helping to solve problems' in a social context, has moral overtones. Consequently, attention is paid to notions of 'problem solving'. Given the Christian ethic of 'telling (rather than concealing) the truth', I am also concerned with the use of information, and of information technology (in the broadest sense), in OR practice. Thus these particular 'interests' have done much to influence the choice of research subject, and the development of a framework for describing OR practice, as described in the following sections and in the next chapter.

2.3 Details of Fieldwork

In this section, the fieldwork heralded in section 2.1.1 is described in greater detail. Firstly, an approach to gathering data through in-depth interviews is discussed. The experiences of conducting a pilot study are then recounted;

here, a suitable loose structure for interviews is developed. Finally, the design of a survey of OR practitioners, and the specific data management methods used, are discussed.

2.3.1 Interview methodology

One of the advantages of interviews (over observations) is that the interpretation of workaday OR practice is done primarily by OR practitioners themselves, though in collaboration with the interviewer. However, there are some complex issues, regarding the use of interviews, which remain to be addressed. An interviewer, like an observer, necessarily brings preconceptions, expectations and various other 'baggage' into the study. Part of this baggage is the conceptual framework that will be used to order and interpret raw experience, but there will also be covert expectations.

Edmund Husserl's phenomenology is based on the premise that a person can only truly have knowledge of what is in his consciousness or Lebenswelt - the "entire constellation of sensory, affective and cognitive events observed as subjectively 'there' by the person at a given time and place" (Massarik, 1983). [From a Christian perspective, one could assert, in partial agreement with Husserl, that it is *in* the Lebenswelt that knowledge is formed, but that the objects of knowledge may have ontological status.] Science must, therefore, begin with *critical reflection, or meditation, aimed at identifying and suspending preconceptions*, so that the phenomena in the Lebenswelt can be directly experienced and understood (Husserl, 1965, Schutz, 1962).

Massarik (1983) describes what he calls "the phenomenological interview". This requires both interviewer and interviewee to employ a phenomenological method, as described above, and to commit themselves to a joint search for true understanding. Massarik concedes that the ideal interview would require unlimited time and energy, and complete mutual trust and

commitment. While this may seem practically ridiculous, if not humanly impossible, these ideas can be accepted in principle and can be adapted and used to *some* advantage in interview design.

In Bryman's book on "Doing research in organisations", Buchanan et al. (1988) offer much advice which is consistent with the implications of phenomenology. They claim that "rich information is a product of close relationships of mutual trust and respect". To this end, I have attempted to 'use' embryonic relationships with OR practitioners, developed through OR Society events, to enhance the quality of interviews. I consider this relationship-based approach to fieldwork to be consistent with Christian ethics.

Buchanan *et al* consider that "most people are flattered by reasonable requests to talk about themselves", though such requests must not appear threatening. They refer to a collaborative research project which was arranged in a real ale bar. They advise that researchers should possess genuine curiosity about other people's experiences, that they should feel comfortable (and make other people feel comfortable) in interviews, and should display interpersonal sensitivity. I have attempted to adopt these principles in approaching potential interviewees, and also in conducting the interviews themselves.

A Hermeneutic Process

Apart from the practical difficulties in conducting a purely phenomenological interview, I am deliberately trying to use and develop a language for describing OR. Moreover, I may be changed, in some way, by my experience in pursuit of truth. The research process is therefore a hermeneutic one, involving an ongoing dialogue between researcher, research method and language on the one hand, and descriptions of OR practice on the other. [The discussion about the nature of truth and science, in section 2.2, is part of this experience.] It is

essential to reflect on the implications of using one framework, rather than another, as certain types of information will be emphasised and others excluded. It is also important to be sensitive to practitioners' experiences that do not fit easily within the interview schedule or conceptual framework, and to alter these frameworks accordingly.

2.3.2 The pilot study

The pilot study consisted of interviews with nine OR/MS practitioners in six different organisations. One interview was conducted with each practitioner. Each interview lasted between an hour and a half and an hour and three-quarters.

Preliminary reading of literature concerned with the practice of operational research or other management science or problem solving activities suggested frameworks which might be useful for underpinning the pilot study. Conversely, it can be said that the pilot study provided an opportunity to test these frameworks, to see if OR practice could be described in such ways, and to see if these frameworks promoted useful debate. The two areas of work which were most influential at this early stage were that of Schein's "process consultation" (1969) and Cropper's "ways of working" (1984):

The concept of "ways of working" was originally used to describe the consultancy practice of a group of "primarily academic operational researchers engaged in the development and use of what are known as 'soft' OR methodologies" (Cropper, 1984). Briefly, ways of working are the ways in which technologies and methodologies are used to help clients; and the rationales behind technologies and methodologies.

Five interviews were conducted in which discussion was focussed around five themes, based on aspects of Cropper's work:

(i) OR practitioners' environment - including the nature and identity of clients, and ORers' way of conceiving and formulating problems;

(ii) OR consultants - their roles, in relation to clients and their problems;

(iii) Technology - interpreted in a broad sense to include all "theoretical and modelling structures", whether analogue, computer, mathematical, diagrammatic or conceptual models;

(iv) Management - including project management (how ORers manage time, events etc.), and process management (how they deal with issues of power, conflict, politics etc.);

(v) Finishing - overall aim of OR work, its products, and the way ORers' draw OR projects to a close.

These interviews succeeded in providing rich background information about OR practitioners, and gave a good 'feel' for the nature or their work, at a very general level. However, they also demonstrated that it is quite difficult to 'pin down' OR practitioners, to find out *what they actually do* on a day-to-day level.

The next two interviews were based on the framework that Schein used to describe his own work, as "process consultation" (Schein, 1969). This approach "involves the manager and the consultant in a period of joint diagnosis" of issues relating to social processes within the client's organisation. Although, I recognised that ORers' aims may be different from those of an organisation development consultant using Schein's approach, the framework consists mostly of administrative events and processes to which most organisational consultants can relate.

With hindsight, it is apparent that these interviews were also influenced by the descriptions of the 'process of OR' which appears in OR textbooks (such as Ackoff and Sasieni, 1968). Here, OR is described as stepwise procedure involving problem formulation, model building, and data collection amongst other activities:

(i) Identity of clients, and other organisational information;

(ii) Initial client contact;

(iii) Conduct of meetings with clients, and approach to problem formulation;

(iv) Data collection; etc.

Subsequent topics were guided by answers to questions such as "what do you do next?"

These interviews succeeded in eliciting more detailed information about OR practitioners work. However, data was related to a rather rigid time axis, from the beginning of a project to the end. This data lacked a *context*, namely the OR practitioners' *role*, or *paradigm of operation*, in a general sense. It should be noted that Schein's use of a stepwise framework appears in the second half of his book; the first half gives a thorough introduction to the *nature* of process consultation.

The final two interviews were designed to achieve a balance between the extremes of the first two phases of the pilot study. These interviews focussed on the following issues:

(i) Identity and nature of clients, ORers' relationships with clients, and project administration;

(ii) Origins of project work, and ORers' approaches to problem formulation;

(iii) Use of technology;

(iv) Overall aim, and products of OR work;

(v) ORers' approaches to politics, conflict etc.

By this last stage of the pilot study, my confidence in the process of interviewing had increased. Moreover, the responses of interviewees, and the language they used, became gradually less surprising as the study progressed. Consequently, the later interviews were less rigidly, and more skilfully, structured than earlier ones. These interviews did cover the subjects as intended, but often not in the sequence shown above. Instead, interviews proceeded as more natural conversations, subtly directed to focus on each of the listed topics.

By the end of the pilot study, it became clear that in seeking to gain a thorough understanding of OR practitioners' roles, their environment, their relationships with clients, their technology and their *modus operandi* at both a general level, and also in terms of their day-to-day behaviour, I was trying to achieve an unrealistic amount in a single interview. For most OR practitioners, this kind of interview is a novel experience. Indeed, serious conversation about these subjects is a fairly novel experience.

I chose to conduct the main body of fieldwork in *pairs of interviews* with OR practitioners: the first interview would have to explore ORers' roles and environment, on a general level; the second interview could then explore workaday behaviour. The data from the second interview would be *set in context*, and more easy to interpret and understand then similar data from the pilot study. Indeed, it became possible to design second interviews *after* first interviews had been

carried out, taking into account what had and, significantly, had *not* been discovered during first interviews.

2.3.3 Survey design

Initially, I had hoped that it would be possible to interview 20 - 30 OR practitioners. While being practically viable, this would have made it possible to ensure a broad representation of the OR community, and to make comparisons between various sub-groups within the community. However, the pilot study showed that two interviews would need to be carried out with each practitioner. This would have the effect of *more than* doubling the amount of useful data that could be collected from each practitioner. Consequently, the sample size would have to be reduced to around ten.

Clearly, a sample of this size does not permit comparisons between sub-groups to be made. The aims of the study needed to be modified, such that identification of *commonality* in OR practice took priority over *variation*. *Detailed description of normative OR* became the main aim of the study.

A number of factors were influential in selecting a sample for interview:

(i) Representation - Extensive surveys reported by the OR Society's Commission on the Future Practice of OR (ORS, 1986) and by Carter (1987) give the distribution of the OR community according to various factors such as age, experience and sex of the practitioner, title and size of the group to which he / she belongs, size and business area of the organisation of which the group is part. My sample was designed to reflect, approximately, these distributions.

(ii) Personal Contact - The reasons for contacting potential interviewees who were already familiar with me personally, the research, or the polytechnic, has been explained above.

(iii) OR Society - Personal contact was made through the OR Society, though interviewees are not necessarily all members of the Society. Much OR is done by people who are *not* involved in the OR Society, and by people who do not even like to use the name "OR". There is no register of OR 'professionals'. Consequently, there is no perfect, or obvious, sampling frame. I chose to concentrate on people who are happy to be associated with the name "OR", and to be part of its culture. It is these, and only these, practitioners who would be happy to be considered 'normal' ORers - viz. the aim of this research - and who would be interested in, and influenced by, the research findings.

(iv) Convenience - Some interviews required long journeys to be made to ORers' places of work, where this was felt to be necessary. However, where geographical location was not thought to be relevant to the nature of practice, ORers were chosen who could be visited reasonably easily.

Sample

A total of *ten* practitioners, in different organisations were invited to be interviewed. Two of these declined, notably on the grounds that they are "not really OR people". This reinforced the idea in (iii), above. Furthermore, little or no personal contact had previously been made with these two people - thus reinforcing (ii), above. Consequently, eight 'mainstream' ORers were interviewed. The details of this sample are given in the following chapter.

Interviews

In one case, an ORer was unable to participate in a second interview. In the other seven cases, two interviews were carried out. All interviews lasted between 1½ and 2½ hours. Twelve interviews were conducted during visits to an interviewee's workplace. Two interviews were carried out at

Sheffield Polytechnic. One (with the ORer who was only interviewed once) was carried out in a hotel lounge.

All interviews, except the one in the hotel lounge, were recorded using a Sony M-12 micro-cassette recorder. This proved much less obtrusive than a bulkier tape recorder and microphone that had been used in the pilot study.

Data Management

Extensive notes were made from interview recordings - approximately 3-5000 words per interviewee. Some sections were transcribed fully, but I decided that transcriptions of whole interviews (potentially 10-20,000 words per interviewee) would be very time-consuming, and that the data set would become unwieldy. The complex nature of the conversations precluded the use of clerical staff to provide transcripts.

I began the analysis of interview data by copying notes and quotations, under various headings, onto large sheets of paper (originally for backing wallpaper) in different coloured pens. I found this to be an invaluable technique because (a) it allows large amount of data to be viewed at one time; (b) data from interviews with several different people can be aggregated and compared; but (c) individual practitioners' experiences are retained as distinct wholes.

Chapter 3

O.R. PRACTITIONERS

This chapter serves three purposes. Firstly, it provides an introduction to the sample of OR practitioners who were interviewed in this research. Secondly, it introduces the conceptual framework that was used to structure the interviews, and which *forms the basis* of the structure underpinning the description of OR practice contained in this thesis. Finally, this chapter serves as an introduction to the subsequent chapters of the thesis, by explaining how each chapter utilises a particular part of the framework.

In order that the discussion in this chapter should flow sensibly, I shall begin by describing the framework used to structure the fieldwork. I shall compare it, briefly, with other kinds of framework that have previously been used to underpin statements about OR. Part of this framework was used to elicit some information about the OR practitioners themselves (as distinct from what they *do*, in their jobs). I shall, therefore, begin presentation of results from the fieldwork by discussing these findings about the identity and nature of OR practitioners. I shall then explain how the remainder of the thesis is structured, with reference to the conceptual framework.

3.1 Conceptual Framework Underpinning Interviews

Two interviews were used to elicit four types of data. The first interview covered the following topics:

Demographics and background of practitioner,
Nature of practitioner's organisation,
Nature of OR group, and administrative procedures,
Practitioner's view of OR, aims in OR, and
reasons for being involved in OR,
Practitioner's role in terms of clients, problems, and
technology, the relationships between them, and
their relationship with the practitioner.

The second interview covered the practitioner's day-to-day behaviour - the practical outworking of the aims and role described in the first interview.

The topics covered are similar to those covered during the pilot study (see chapter 2). However, this stage in the research marks the emergence of the conceptual framework which *forms the basis* of that which underpins the description of OR practice in this thesis. In this section, I shall describe this framework, and compare it with its predecessors.

Following the pilot study, it seemed that there were *four basic actors or entities* which were vital components of all the different OR practices which had been investigated at that stage. As a general statement about the nature of OR, it could be said that:

Operational Research is about being a consultant (of sorts),
to a client (of sorts),
to help with a problem (of sorts),
with the explicit use of models or technology
(of sorts).

This four-cornered, or *pyramidal* model can be depicted as in figure 2, below:

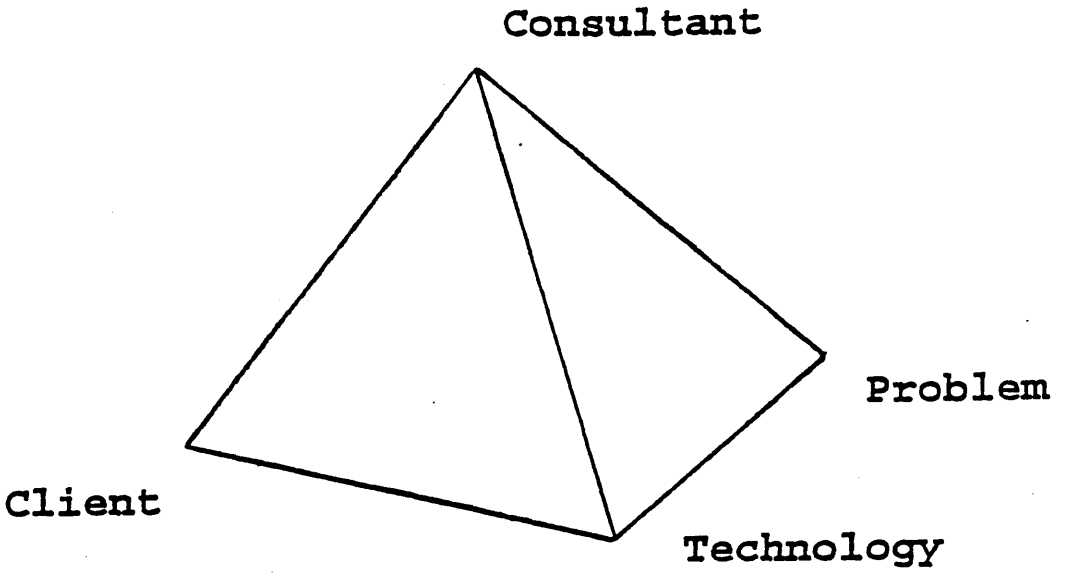


Figure 2

The nature of the four components, and the connections between them, will be discussed throughout this thesis, but some brief explanation is necessary here.

Firstly, this model is a conceptual *framework* to *underpin* actual description of OR. The general statement of OR, above, is not necessarily a *definition* of OR, in the sense of embodying a clear system of meanings which distinguish OR from other activities.

The model's components can take a number of different forms, within OR (though they may not take all these forms). For instance, a 'client' may be an individual, group or organisation, and this component can be used to refer to any other non-OR people involved in OR practice in some way. Similarly, I am not assuming any *particular* meaning of the term "problem", at this stage. It is simply a *concept* which

proves valuable in describing OR. The terms "model" and "technology" are used to refer to a variety of possible *tools* used *by* ORers, but which are, in some sense, separate from them. I am thinking, here, of *explicit* representations of something, using 'natural' language, mathematics, diagrams, computers etc.

The major influences in the development of this model were:

1 The "*ways of working*" model, developed by Cropper (1984), which was partially successful in framing pilot study data;

2 My increased familiarisation with simulation modelling, in terms of *entities and activities*;

3 Exploration of the possible use of *'systems'* methodologies, particularly that of Checkland (1981), for describing OR practice as a "human activity system".

As I noted in the opening chapter, the most commonly used conceptual framework is a logical / chronological sequence of activities which refers to problems and models, but not to consultants or clients. An early recognition that this framework was inadequate for describing the social reality of OR practice was Mathew's (1957) framework which comprised "tactics" (a sequence of activities), "tools" (a variety of analytical techniques), and "team" (OR workers and other analysts).

More recent reflection has resulted in consultancy-based models. Hildebrandt's (1977) "participative" model comprises "phases" (a sequence of activities), "interest groups" (clients, managers and others), "strategies" (consulting roles or stances) and environmental variables and constraints. Scholz (1983) uses a systemic model in which operational researchers, clients and OR models and methods come together to form an OR "process" (a sequence of activities). The same

triad of client, consultant and models has also featured anecdotally in much other OR literature (eg Smith, 1978, Eden, 1986). Hudson (1984) uses something close to the four-cornered model that I am using here when he describes OR as "FAD" - comprising facts and models (F), advice and consultancy (A), and decisions and actions (D). In his terms, A and D are common to other consultancy activities, but F is *characteristic* of OR.

Erich Jantsch uses a model of a Nature-Man-Society-Technology system in "Technological Planning and Social Futures" (1972) which bears a remarkable similarity to my OR framework. Jantsch's system can be

> "broken up into six 'bi-polar' subsystems, each of which represents the integration of two of the four basic elements".

His concern is with technology, but, rather than referring to "relatively superficial and peripheral features of specific technological developments", he adopts a "function-oriented strategic planning framework" for considering technology. Here, it is the *function* of technology, in each of the various bi-polar subsystems, which is the focus of attention, rather than the technology *per se*.

In the view of OR based on the pyramidal framework, it is problems which provide the backdrop to ORers' use of technology in a social context. OR can be investigated and described by pairs of entities, and their interrelationships i.e. consultant/client, consultant/problem, client/technology etc. More sophisticated discussion can be underpinned by three-cornered, or even four-cornered frames. At each higher level, features of OR practice *emerge* which cannot be discussed at lower levels. In terms of the pyramid in figure 2, debate can be supported by points, edges, faces and ultimately by the entire pyramidal structure.

These different types and levels of debate are all represented in the chapters of this thesis. Towards the end of this

chapter, I shall outline the topics covered by each of the chapters. The sections which follow, here, begin the debate by introducing the *OR practitioners* themselves. Firstly, basic facts and figures are presented which help to relate the nature of the sample to the wider population of OR practitioners. In the subsequent section, the ORers' own notions of the *nature of OR* are considered, along with their reasons for choosing (or ending up in) the OR profession. As will be seen, these sections lend support to the remainder of the research findings by confirming the use of the pyramidal framework, and by demonstrating basic similarities between the sample and the wider population of OR workers.

3.2 The Sample of OR Practitioners

Practitioners were selected - by *judgment sampling* - according to certain known factors - namely sex and approximate age of the practitioner, title of the group in which the practitioner works, and business area and geographical location of the practitioner's organisation. The aim was to assemble a group of people which was broadly representative of a cross-section of the practicing OR community.

Eight OR practitioners were interviewed. However, one of these was interviewed only once, thus making it unlikely that all the required data could be collected. Furthermore, during this interview, it became clear that this man, like those who declined to be interviewed, had never been a 'full-time' OR practitioner, and that he had now reached a management position such that his role could not be described using the categories which had been used to describe 'other' OR practitioners' work.

This man was the last person to be interviewed. Consequently, it was already possible to judge that his work could not easily be compared with the rest of the data. I considered it

appropriate to 'remove' this interviewee from the sample. This does *not* mean that I am making an *a priori* decision to label his work as "not OR", in order to retain a framework which is actually incapable of holding all the data; rather, I am simply facing up to the fact that this man's work is *categorically* different from the rest of the sample. Further, the frameworks needed to describe these different roles are incommensurable, and the development of alternative frameworks, and also a methodology for choosing between them is beyond the scope of this research. It is already clear that the work described in this thesis may not be representative of *everything* that is referred to as "OR". In particular, it seems that 'OR-type' work which is done by people who are not recognised as, nor would recognise themselves as, full-time OR practitioners (Lee et al., 1989) may be categorically different from that done by people who *are*.

The sample of seven OR practitioners included one OR manager, and one external consultant who, by his own admission, does a very different kind of work from most other ORers. As with the manager who was removed from the survey, it is recognised that these two people's roles could not be as *fully* and *easily* described (with the chosen framework) as the others'. Consequently, the description of OR which appears in this thesis is based largely on the work and methodologies of the other five OR practitioners.

Apart from the 'demographic' factors which guided sample selection, certain other easily measurable factors were recorded during interviews - namely, practitioners' experience, qualifications, and job title, and the size of both the group and the organisation. All these factors have been measured in much larger surveys of the OR community, notably those by Carter (1987, 1988) and ORS (1986). It is, therefore, possible to compare the small sample used in this research with these larger samples, and to comment on how well the population of OR practitioners appears to be represented

in my sample. Detailed comparisons are made in Appendix B. In this section, I shall just summarise the main implications of these comparisons.

Job title, and group title,size and age

The five practitioners whose work forms the basis of this thesis all worked in groups bearing the name "OR", although two of these groups were part of larger management support departments. These five included two senior, and two junior OR analysts, and one corporate planning analyst. The other two interviewees were a manager of an OR group, and an external consultant. Group sizes varied between 1 and 35, with a median of 10 people. On average, the OR groups in the sample have been in existence for about 20 years, in various forms and under various titles.

Business area, and organisations' location and size

Practitioners were drawn from a variety of industries, including a nationalised industry, national and local government, finance, distribution and food manufacture. Two practitioners (in finance and government) were based in London, whilst the others all worked in or near Yorkshire. The size of ORers' organisations varied from 1 to 90,000, with four ORers working for organisations with over 50,000 employees.

Sex, and age of practitioners

All of the ORers interviewed were male. Ages varied from 23 to 58 with a mean age of 37.

OR experience and qualifications of practitioners

ORers' experience varied between 1 year and 35 years, with a mean of 14 years. All are qualified to first degree level; two also have an MSc (in OR), whilst one has a PhD.

Discussion

On the whole, the demographic comparison, between this small sample and the larger ones used by Carter and the ORS Commission, is pleasing (see Appendix 2). When all the above characteristics are considered, the OR practitioners in my sample appear to be *broadly representative* of the wider community of practicing ORers. Clearly, a sample of seven would not normally be considered a statistically valid basis for inference. However, the use of this sample is partially validated by these similarities.

There are, however, three features of the sample which are worthy of comment as they may betray undesirable bias:

(i) The figures above suggest a slight under-representation of people who have recently entered the OR profession, via MSc courses - many of these *recent* entrants are women. However, two men in the sample had less than 2 years' experience, and have both taken specialist OR courses, so this bias may not be too significant. One woman was invited to participate, but she declined.

(ii) Clearly, OR-type work that is done in non-OR departments is under-represented. The description of OR practice which is contained in this thesis is based largely on the experience and views of five in-house OR analysts. It should, therefore, properly be considered as a description of in-house OR analysis. The interviews with one OR consultant and one OR manager have been insightful, but they have not yielded enough

data to permit a description of the greater variety of OR work carried out in these different roles.

(iii) OR practitioners in engineering and manufacturing industries are missing from the sample, as are those in systems/computing groups. This may result in a relatively non-technical picture of the nature of OR.

3.3 Definitions of OR

"Oh! You swine! You want me to answer that?", was the response of one interviewee when asked to give a general definition of OR. However, five of the practitioners produced a definition with considerable ease, and these showed marked similarities. A sample of the responses are shown below:

> "helping people or a process to perform in the best possible way, within a set of constraints .. and in order to do that, we'll apply a logical or scientific approach"
>
> "an internal consultancy service - more at the quantitative end, using statistics, modelling - working at boundaries, with problems of change .. information systems"
>
> "providing a problem-solving service service to management, with certain attention being paid to the techniques we use to solve those problems - use of analytical techniques, scientific method, and common sense"
>
> "solving management problems in a structured, scientific manner".

All the practitioners interviewed defined OR in a way that explicitly referred to each of the components of the pyramidal model (with the exception of the ORer him/herself): All referred to management or consultancy; all referred to problems - either explicitly, or by reference to improved performance; all emphasised that ORers have characteristic methods or technology.

Curiously, when the OR Society ran a competition (in 1974) to find a definition of OR, the balance was somewhat different: Virtually all the entries referred explicitly to ORers' techniques or approach; most referred to problems, if only through rather oblique implications that nature and organisations need analysing; but only a handful mentioned clients, consultancy, or any people at all. The winning entry (thoroughly discussed in Beer, 1966) which graced the pages of the ORS journal for many years, was as follows:

> "the application of the methods of science to complex problems arising in the direction and management of large systems of man, machines, materials and money in industry, business, government and defence. The distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as chance and risk, with which to predict and compare the outcomes of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically".

Again, the components 'client, problem and technology' can be distinguished. However, the "purpose" of OR, namely "to help management .. " comes only in the last sentence, presumably being logically or syntactically subordinate to the methods used. Even here, "management" is referred to by the impersonal pronoun "it", and the OR person him/herself is not mentioned at all.

When approached for interview, the practitioners in my sample were given some idea of the kind of topics that I wanted to discuss. It is possible, therefore, that their definitions were coloured by knowledge of my interest in *consultancy* practice. It is possible that ORers consider consulting issues to be unworthy of representation in a formal statement about OR, but this seems unlikely, as the definitions, above, *are* quite formal. It is also possible that there has been increased recognition of the social nature of OR during the last two decades. During the early 1970s, the ORS journal contained roughly one paper per year which dealt to any notable extent with consultancy or social issues in OR. This

increased to about three papers during the late 1970s, and to about five papers during the early 1980s.

3.4 Motivations for Practicing OR

Practitioners were questioned about their reasons for choosing a career in operational research.

> "Bloody 'ell! It's like a job interview, this!",

one of them remarked.

The 'people, problem and technology' aspects of OR are apparent from practitioners' reasons for doing OR as a job. Several interviewees explained that their career 'choice' was a "consequence of life decisions to date". Most of the practitioners interviewed have a background of education in mathematics and/or statistics. They view OR as an opportunity to *apply* their learned skills in a practical manner. However, this should not be taken to mean that OR is merely an escape route for disillusioned mathematicians. As one practitioner explained,

> "I *do* enjoy the process of analysis, I *do* quite like playing with computers, .. I'm that kinda guy".

Several OR practitioners in the survey explained that OR gives them the opportunity to "meet interesting people". They recognise OR to be a social activity, and *enjoy* the interpersonal interactions that it involves. This evidence is contrary to Weinshall's claims (1989) that

> "one of the reasons for individuals choosing a more quantitative career is their desire to avoid, as much as possible, interpersonal relationships within and outside organisations".

Not only is OR a socially involved profession which its practitioners enjoy as such, but they also adopt and enjoy an altruistic stance of

> "helping people - to do something better - easing people's headaches".

Interaction with problems also has intrinsic satisfaction for ORers. One practitioner explained that "solving problems, small or large, has a sort of adrenalin to it". Another practitioner referred to the "satisfaction of being able to come up with an answer, sometimes". Another enjoys the challenge of

> "going into something you don't understand, and learning to understand it, and change it".

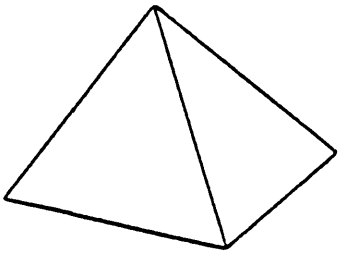
There is a strong sense of "intellectual challenge" in OR, which is enjoyed by practitioners.

It is clear that involvement with people, problems and methods and technology all hold intrinsic satisfaction. The overall effect is the challenging experience of working at an "interesting interface of analytical skills and problems of management". Several practitioners cited "variety" as a major reason for continuing in OR - "you do *not* have two days the same".

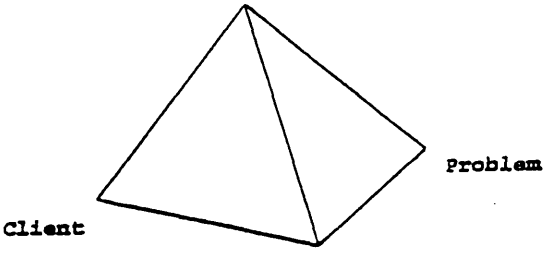
3.5 Structure of The Thesis

The main body of this thesis, from chapter 4 to chapter 9, describes the nature of OR practice. The discussion within each chapter is related to the four-part systemic framework introduced earlier in this chapter.

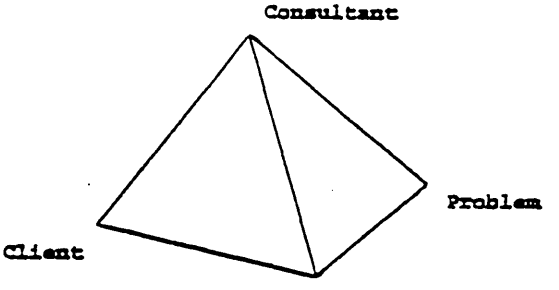
Chapter 4 describes the social and organisational context of OR work. Here, the identity and nature of ORers' clients, and other non-OR people involved in OR work, are described. This broadly corresponds to the "client" pole of the system.



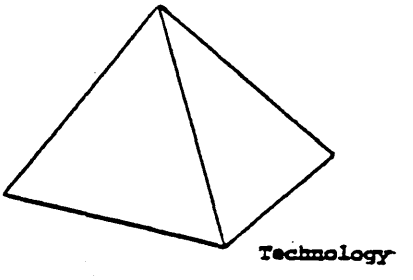
Chapter 5 is concerned with the nature of the problems that are construed and encountered in OR practice. In particular, the relationship between problems and the clients with whom they are associated is discussed here.



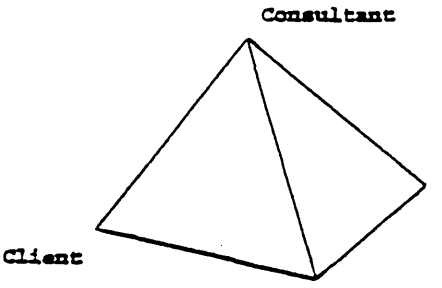
Chapter 6 describes OR practitioners' interface with the world of (clients') problems, and their contribution to problem-solving. This is necessarily a 'higher-level' description, based on a three-cornered 'face' of the model.



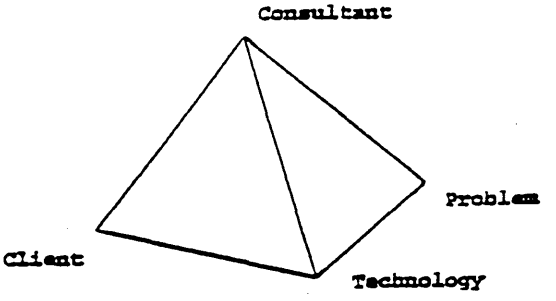
Chapter 7 returns to a 'uni-polar' description, this time of the nature of the models, methods and technology that are used in OR practice. This 'pole' is often assumed to represent OR in its entirety, but here it is portrayed as only one part of a system.



Chapter 8 is concerned with the relationships between OR practitioners, and clients and other people. This is a traditionally 'bi-polar' description of the 'consultancy' aspects of OR.



Chapter 9 returns to describe OR's technology, but this time with regard to its *function*. The use of technology, in the context of consulting relationships, and of problems, is covered here. All four poles are considered, here, but the emphasis is on the technology pole, and its connections with the other three poles.



Chapters 10 and 11 both consider OR in general terms. Chapter 10 presents a critical summary of alternative frameworks for describing OR, and alternative ways of characterising the overall 'process' of OR. The development of the pyramidal framework, during the course of the research, is also discussed.

Chapter 11 considers assessment of the effectiveness of OR practice, and also considers ways of promoting effectiveness. Professional education is offered as a way of promoting effectiveness, through the application of the 'science' of OR practice and methodology that has been developed in earlier chapters.

Chapter 4

THE SOCIAL CONTEXT OF O.R. INTERVENTION

This chapter is concerned with the social context of operational research intervention. There are three main aspects to this: I shall consider the identity, and roles, of the people who make up the immediate social environment of OR work. There are a variety of people who can be regarded as *'clients'* of OR, in some sense. There is another group of people who may *become* involved with OR practitioners during the course of a project. The nature of the *decision-making processes,* which involve these various organisational actors, will then be discussed. The role types and models that are used in these sections will stand as points of reference throughout this thesis. Finally, I shall consider the *organisational position* of OR workers, and the organisational *procedures* which influence the conduct of OR work.

My main aim, in this chapter, is to describe the *context* of OR work, to lay a foundation for the following chapters which are concerned with the nature of ORers' consultancy interventions. However, it is important to acknowledge that I am relying on the interviewees' *constructions* of their world, and of the significance of various social actors within it. These constructions are at least partly factual, but it is likely that different actors would construe the 'same' situations slightly differently. The significance of the viewpoints adopted here is that it is OR practitioners' constructions of their world which *inform their methodologies*.

4.1 Clients

The simplest and most common way to describe the social context of OR is to refer to an individual - "the client" - with whom the OR consultant must relate and work. This does not, however, do justice either to the complexity of the interactions which can take place during the course of OR work, or to the ethical and methodological dilemmas which consequently face the operational researcher. One practitioner described the situation thus:

> "In my mind, I would very rarely use the word "client". I consider myself to be involved with a lot of people ... I try to treat them as colleagues."

In the following sections, the identity of this "lot of people", and the roles that they play in and around OR practice, are discussed. These discussions are based explicitly upon interviews with OR practitioners. The names which are used to describe client roles include those used by the practitioners themselves. However, Bryant's (1989) discussion of "roles around interventions" is particularly relevant here.

The 'clients', referred to by OR workers in this study, may be defined as such by one or more of the following characteristics:

1. *Concern* with respect to the OR project topic;

2. *Initiative* to invite or commission a project;

3. *Authority* to commission a project;

4. *Participation* in an OR project;

5. *Decision-making authority and participation* with respect to the project topic.

Often, a combination of these factors will apply. The archetypal 'client' is an individual to whom all 1 - 5 apply. In such circumstances, it is easy for ORers to identify someone as 'the client'. This is more likely to occur in strictly hierarchical and functionalised organisations. If, however, concern, initiative, participation and authority are distributed more widely, then the singular notion of *a* (or *the*) client is less helpful.

4.1.1 Problem ownership

The combination of *concern* and *initiative* (as above) jointly define a role which may be called *'problem owner'*. This is someone "whose *unease* about a situation has *triggered off* the whole process" (Bryant, 1989, emphasis added). [The nature of problems, and the sense in which they can be 'owned', will be addressed in the next chapter. All that needs to concern us at this stage is the truism that no OR work (or any other form of consultancy) would be done unless (at least) one individual felt that there was some issue that people should address.]

Several ORers in this research described the beginnings of projects by quoting a prospective client's declaration, thus:

> "We've got a problem";
>
> "we've got a potential problem".

The notion of problem *ownership* can easily be distinguished in these quotations. However, these project 'initiators' also spoke of *joint* ownership - i.e. it is "we" who have a problem. The following examples of joint problem ownership are common in the experiences of the OR practitioners interviewed during this research:

(a) A small department, or group within a department, may work sufficiently closely within the problem area that any or all of these people are considered (by themselves, and by the OR practitioner) to be legitimate problem owners. For example, a

planning manager and senior planning officers may genuinely share an interest in the development of planning methods and technologies.

(b) Many OR practitioners are called, *from time to time*, to become involved in the deliberations of a working party. We may consider a working party (or "project team" or "task force") to be a group, usually of 5-10 people, drawn from more than one department to address a specific issue. The life of the group, as such, is expected to be of limited duration, though this duration may be initially unspecified. The *raison d'etre* of a working party is a common *concern*. An individual from the party may initially contact the OR group, but the practitioner is expected to show allegiance to the group *per se*.

(c) Some organisations do not operate with a single hierarchical executive structure. For instance, local government and some 'voluntary' organisations have a council and committee structure whose elected members work alongside (in some sense) counterparts in an executive structure. It is likely that members of either part of the structure may have their concerns attended to by operational researchers, but that these concerns will usually be communicated through the executive structure - i.e. an officer will invariably be the *initiator*.

Interviews with OR practitioners produced evidence that ORers are keen to identify an *individual* as the problem owner, wherever possible. Colcutt (1981) expressed the opinion that "when one has a fuzzy client, one does fuzzy OR". Such a person is often referred to as "the client" or "the *real* client", and provides a focus for OR workers' attention. The significance of the role of problem owner will become clearer in the next chapter on the nature of problems.

An individual problem owner is usually a manager whose position within the organisation makes him senior to the OR

practitioner, though often no more senior than the OR manager. Where the OR practitioner operates as an external consultant, he and the problem-owner may assume equal standing. Similar relations apply to the senior member of a problem-owning group.

An invitation to carry out an OR project does not usually arrive entirely 'out of the blue'. This is confirmed by Conway and Holland's research, which began (Conway, 1977) with a study of the origins of OR projects. Their studies revealed that most projects stem from previous OR work. They also revealed that very few projects develop from "hard" selling by OR consultants. Thus the OR role in the initiation of a project varies from simple reaction to a problem-owner's advance, to a negotiative or (occasionally) even proactive stance.

4.1.2 Sponsorship

The above discussion relates to concern with regard to a project *topic*. The role of *sponsor* - or "commissioner" (Bryant, 1989) - describes a person who has the *authority* to commission or formally initiate the OR *project* itself. This authority is closely related to the responsibility of *payment* for the 'services' of OR workers.

Virtually all OR workers are paid a salary in return for their problem-helping efforts. In addition, some other people in their organisations will be required to devote some of their energies to collaboration with these efforts. Consequently, the client organisation must bestow upon someone the authority to decide whether or not a proposed problem-handling project justifies the likely cost in terms of money, time, physical, mental and emotional energy, and the disruption it may cause.

In some cases, the OR group may receive a fee directly from a sponsor within the client organisation. If the problem-owner

is sufficiently senior, he may be able to sponsor the project himself; if not, he may have to secure the support of one of his superiors. However, although it is common for some measure of the cost of an OR project to be made, a sponsor will often have the authority to commission individual studies once an annual or biannual budget or workload has been agreed. This was the case for two of the ORers in this research (at the time when interviews were carried out):

> "basically, we've got to make sure he's prepared to sign a piece of paper to say he's paying for it".

This "sponsorship" may or may not require the rubber stamp of a finance officer (or someone else who nominally holds the key to the organisation's finances).

Some in-house consultants continue to contribute to the overhead costs of their organisation, and are offered as a "free" resource. This was the case for three of the OR practices studied during the fieldwork. Here, control is exercised through an annual analysis of the amount of OR effort that has been used in various parts of the organisation. In such cases, the term "sponsor" may be applied to the organisation as a whole, or to a single director with responsibility for OR work.

On the few occasions when a working party is the (joint) problem-owner, sponsorship is often by a manager who is senior to the group, so that no member of the group is employed by other group members from other departments.

The significance of the sponsor's role goes beyond ensuring that the ORer is paid for his services. In a paper on voluntary OR, Sims and Smithin (1982) conclude that the absence of a sponsor leaves the ORer with a methodological conundrum, as well a financial one: "if you are not being paid for your services, .. how do you decide who your client is, or indeed if you really have one?" Project sponsorship secures the OR consultant in the belief that his efforts are directed

at an issue of real concern, and *reminds* him of the identification of the problem owner (although the sponsor may not actually *be* the problem owner).

4.1.3 Participation and stakeholding

If an initiating problem owner is a senior manager, he may not feel able to devote much time to involvement in an OR project. OR practitioners in this survey explained:

> "One of the consequences of having senior clients is that they haven't much time to give you";
>
> "generally, these chaps are some distance from the problem".

The sponsor may then direct one, or a group, of his subordinates to act as the OR practitioner's point of contact. This is quite common in the experience of the ORers in this survey. This person (or group) may be referred to as "the client", a "contact" client, or as a "user" of the ORer' 'services'. The contact may, himself, be genuinely concerned with respect to the project topic - i.e. he may be a problem owner - or he may become concerned during the course of the project. In these circumstances, whether or not the sponsor's concerns genuinely remain the focus of attention, or whether his role degenerates to that of "puppet" client, depends upon the autonomy of the contact client, and his relationship with his superior.

Alternatively, the 'contact' may be an unwilling and uncommitted deputy for the sponsor. This person, or group, may be called the ORer's "host":

> "A sponsor imposes work on a client, who's not particularly interested in what you're doing".

The term "user" is also used to refer to junior members of a problem-owning group who may actually have to handle any tangible output from the project (information, changes in

procedures, a computer model etc.). These users, and/or a wider group of people, may be responsible for implementing any changes. Bryant (1989) refers to these people as "executors". Typically, many of these people may be quite remote from the hub of problem ownership, occupied by problem owners and sponsors. Their significance to OR workers lies in their value as sources of information, and in the fact that they may actually be contributing to the concerns of problem owners. Another type of *"informant"* is a person who can authorise - or block - access to useful data which is stored within the problem owner's department, or elsewhere. OR workers frequently need to interact with people who administer the storage, retrieval and dissemination of such data.

The role of problem owner has been defined (above) in terms of *concern* and also *initiative* which is related to the *authority* to commission OR work. The roles played by users, executors, and informants may be considered as minor by an OR consultant who is primarily concerned with responding to the needs of someone who has invited him to carry out a project. However, like a problem owner, these characters may also have a deep and genuine concern over a particular topic. These *stakeholders* simply are not in a position to call on the services of OR. It is apparent that the identity of OR's potential 'clients' is heavily dependent upon the authority (and power) relations within its host or client organisation.

ORers may also have to interact with consultants of other kinds, who have been invited to make a special sort of contribution to the same - or a related - project. It seems that the two types of consultant which are most likely to impinge upon OR practice in some way are the organisation and methods (O & M) consultant (or 'engineer'), and the computer systems / information technology consultant. In particular, systems / IT people may be employed to develop and implement computer output from an OR project. The two consultancies must therefore negotiate the boundaries between their respective roles. It is also becoming increasingly common for

problem owners' departments to contain computer specialists. However, the testimonies of the ORers interviewed during this research suggests, perhaps surprisingly, that other types of consultants may not have a particularly significant effect upon the way in which OR is practiced.

4.2 Decision Making

I have not yet referred to the way in which clients are defined on the basis of their authority to make decisions. This section is concerned with the decision-making environment of OR practice. I shall consider the *nature* of decision processes, and present a *model* of decision processes which will stand as a point of reference in later chapters on the mature of OR work. Through this discussion, the *role* of 'decision maker' will be articulated.

Herbert Simon's model of decision making (Simon, 1960) comprised a three-stage process of *intelligence* (searching the environment for decision opportunities), *design* (articulating alternative courses of action), and *choice*. This was primarily a *description* of what managers in organisations actually do, which Simon intended to form the basis of science(s) of decision. Few people would disagree that the basic elements of this model are *present* in decision making. However, beyond this, the foci of descriptive and prescriptive theories of decision seem to diverge quite alarmingly, suggesting that this is not necessarily a *complete* picture of decision making.

Lindley's influential book (1971) is "about the logical processes that *need to be used* in arriving at a decision. It is not much concerned with the ways in which people currently make decisions" (Lindley, my emphasis). Raiffa's approach (1968) "prescribes how an individual .. *should* go about choosing a course of action .." The elements of such prescriptive theory are well articulated by Lindgren (1971):

"(a) the set of possible actions from which one must choose,
(b) the circumstances and basic "laws" that prevail, and
(c) the consequences that result from taking a given action in the face of such circumstances."

In OR methodology, the model of an individual, who is faced with a number of alternatives, which are related to consequences, which are evaluated in order to imply a choice between the alternatives, has taken hold through the classic textbooks. This model can be clearly discerned in White, 1975, and is also used by Boothroyd, 1977. Ackoff (1962) and Ackoff and Sasieni (1968) use the following "decision model" (Ackoff and Sasieni):

$$U = f\ (X,\ Y)$$

where U is the value of a 'system's' performance, X are the controllable or "decision variables" (Ackoff, 1962), and Y are uncontrollable variables / constraints. The *decision* is made by selecting X in order to maximise U.

According to March and Olsen (1976), "such a model is often a poor description of what actually happens", whilst Moscarola (1984) claims that "decision theory .. does not allow us to describe what occurs when decisions are taken in organisations". Moscarola is concerned, as I am, with organisational decision processes as the context of OR intervention. In describing this context, we must look to descriptive theories of decision-making. [*If*, as White (1973, 1975) believes, operational researchers are in the business of trying to improve decision process, then we may also have to contend with prescriptive decision-making, and with its interface with the context of consultancy intervention.]

Elements of real-life decision making, with which OR practitioners must contend, include the following ambiguities:

Ambiguities

(i) Involvement - Each member of an organisation plays a role which is constrained, in part at least, by the behaviour of other members. Consequently, social processes of interaction, argumentation, advocacy and game playing can impinge on decision processes. The people involved in these processes have diverse interests, and varying degrees of commitment to a particular stream of decision processes (March and Olsen, 1976).

(ii) Decision points - The notion of a decision is a slippery one. We may take it that a decision is a *result of a deliberation, which leads to action*. March and Olsen (1976) refer to "choice opportunities" when an organisation is expected to produce behaviour that can be called 'a decision'. However, since persons inside and outside formal organisations are continually deliberating and acting, it is often difficult to pin down a specific occasion when a specific decision has been made (Bevan and Bryer, 1978).

(iii) Decision process - The articulation of the various elements of the 'classic' decision models - alternatives, circumstances, relations, consequences, objectives - is likely to be problematic in some way. Much formal decision theory and analysis focuses on manipulation of the relationships between alternatives and objectives. The major business of defining decision makers, and the elements of the decision are often assumed to be non-problematic.

(iv) Conflict - Each member of an organisation pursues his own ends within, and sometimes in spite of, the established framework and objectives of the organisation. It is possible that an OR project may exacerbate this tension between members' interests, and lead to various parties "deciding" upon contradictory or even confrontational courses of action.

One 'type' of decision making which is of particular interest is *"strategic"* decision making. There are a number of reasons for this. Firstly, most ORers include "strategic" work among their aspirations, while some recount, with pride, that they are able to do this kind of work. [Further, the OR literature indicates that the issue of OR's (possible) involvement in strategic decision-making is widely regarded as a critical factor in the development of the profession. See Houlden, 1979, Hemmer, 1983, for examples.] Secondly, one practitioner in this study considered his work "more at the strategic level".

Thirdly, the social nature of decision making, and the incidence of ambiguities (i) - (iv), above, tend to be relatively widely acknowledged in descriptions of 'strategic' decision making. Consequently, it is possible that *models* of strategic decision making could, with some adjustments, be used to reflect decision making in general.

For these reasons, I shall now consider strategic decision making, and introduce models of strategic processes which seem to provide adequate descriptions of the decision environments of the OR practitioners interviewed during this research. In particular, the environment of the ORer working at 'strategic' level will be considered.

4.2.1 Strategic decision making

First of all, it is necessary to consider features of decisions which might cause us to label them as "strategic". Steiner and Miner (1977) provide a fairly comprehensive list of the distinguishing characteristics of (so called) strategic decisions:

1 Importance - effective in determining the organisation's success or failure,
2 Made at a senior level in the organisation,
3 Long time-horizon,
4 Made at irregular intervals,
5 Unstructured and complex,
6 Require lots of subjective information concerning the organisation's environment,
7 Broad - not detailed,
8 Outcomes are difficult to evaluate.

Colloquial usage of the term "strategy" suggests an emphasis on *ends* rather than *means*, although Ansoff (1984) defines *objectives* as 'ends', and strategy as the *means* to these ends. This 'ends'-orientation is reflected in Steiner and Miner's criteria of importance, breadth, time-horizon, and concern with environmental factors.

Weitz and Wensley (1984) urge caution regarding the coincidence of the eight factors above. There is, they say, no evidence that decisions made through the kind of processes described by criteria 2 to 7 are actually important i.e. that they are significant determinants of an organisation's success. However, it is generally accepted that broader, wider-ranging decisions, that must necessarily be taken by senior managers, are of great importance. If this was not so, those managers would be unable to justify their seniority. A more awkward inconsistency within Steiner and Miner's criteria is also suggested by Weitz and Wensley:

> "if strategic decisions are difficult to evaluate, then it must be an act of faith rather than empirical evidence that leads one to regard them as important."

In recent years, there has been much recognition of managers' need to make decisions which are "messy" or "unstructured" - "cauldrons of seething values, views, and objectives" (Churchill, 1987). This 'type' of decision, which is usually called "strategic", is usually thought to be the domain of *senior* managers. However, the relationship between the

content and the structure of decisions is questioned by Friend (1987) who warns that

> "it is a mistake to assume that complexity of decision structure is too directly correlated with variables such as organisational level or time-span."

Friend and Hickling (1987) offer a completely different use of the "strategic" label -

> "choosing in a strategic way rather than at a strategic level. For the idea of choosing at a strategic level implies a prior view of some hierarchy of levels of importance in decision-making."

They emphasise "the connectedness of one decision to another" and apply this notion to "any decisions .. whether they be at a broader policy level or a more specific action level."

From this discussion, it is apparent that the meaning of the phrase "strategic decision-making" cannot be taken for granted. Lists of definitive criteria, such as Steiner and Miner's, should be regarded as an eclectic view of common uses of the phrase.

Most OR practitioners include working on "strategic" issues among their aspirations. "Strategy" suggests importance, greatness, and a concern with fundamental issues. Obviously, ORers would like their work to have a substantial influence on the fortunes of their organisation. Moreover, the implied involvement with senior managers, as clients, can have a beneficial effect on the development of the OR group and on the career paths of the individual OR workers. OR workers like to project an *image* of strategic involvement: A survey by Holland (1988) showed that, in the absence of more specific guidance, "project leaders would like to describe most if not all of their work as strategic".

A model of strategy formulation which has been suggested by Vancil, plus Radford's model of complex decision processes, will now be used to aid analysis of OR practitioners' (actual

or potential) contribution "at a strategic level". This will later be used to describe organisational decision making in general.

4.2.2 The process of strategy formulation

For Vancil (1976), strategy formulation involves managers at *corporate, business and activity* levels, and consists of a

> "progressive series of agreements on *objectives, constraints and policies, and plans and goals*" (emphasis added):

(i) Objectives - aspirations to be worked towards in the future;

(ii) Constraints and policies that define the scope and nature of the organisation's activities;

(iii) Goals and plans to be executed, within the above constraints, in pursuit of the objectives.

Strategic decision making simply consists in the making of commitments to specific objectives, constraints and plans of action. The "strategic" work reported by one OR practitioner in this research was with business managers: "We're below 'blue skies' level. We will help a business manager develop a business strategy for 5 years, 10 years, whatever". These managers must formulate *objectives* which "support, in some appropriate way, the objectives of a person higher up", which are taken as given. The business manager's objectives must also be congruent with the constraints and policies used by his superiors to define the company's role in certain business areas; he must "take that objective [sic] as a constraint".

The manager must define the areas within his own authority, in which effort will be concentrated. These *constraints and policies* must be consistent with his superiors'. He will also

have to take into account the resource allocations planned by his superiors for the next (eg) 5 or 10 years.

Finally, the business manager must make his own *plans*, and set his own *goals* for the next few years. These must be consistent with those of his superiors, and will be set within the constraints and policies which he has defined (above).

Vancil's model is a *bureaucratic* one (see Dunsire, 1978). It provides the organisational context for intellectual decision processes such as described by Simon. In an extreme form of bureaucracy, senior managers exert *control* by issuing very specific *constraints* to their subordinates. As one ORer in this survey said, "there probably won't be much opportunity to question the objectives from higher up". There is, in this case, limited scope for *choice* by middle and junior managers. Consequently, there is little need for discussion between managers and their colleagues, superiors and subordinates. Ambiguities (i) - (iv), above, are either irrelevant to this form of decision making, or are simply ignored.

4.2.3 Complex decision processes

In contrast, Radford (1978) suggests a model of strategic decision making in which social involvement is emphasised. Radford comments that Simon's model, comprising intelligence, design and choice, "does not .. take adequate account of the interaction between participants which is an essential part of the resolution of a complex decision situation" (Radford, 1987). As one ORer in this research put it, "debate is probably taking place between your client, the other members of his group, the people above him, the people below him".

Radford's major refinement of Simon's model is to view the third, "choice", stage as "*interaction* between two or more of the participants in the decision situation". A second refinement is that the "design" stage is developed into an

analysis stage in which each participant articulates his/her own preferences, imagines those of other participants, and articulates his tactics for persuading them in the interactions which follow.

In this model, each decision participant is tentatively formulating the *objectives, constraints and plans* which Vancil describes, but he is also anticipating those of his colleagues. Each participant is, therefore, articulating *proposals* (Boothroyd, 1978) - i.e. what he would like to decide - rather than actually making *decision commitments*. [He may, or may not be sufficiently forward looking and politically aware to be able to articulate the proposals that he imagines his colleagues will be offering.] A similar process is described by Eden (1987) who depicts a decision-making group arguing through a set of proffered solutions.

4.2.4 An integrated model of decision making

Clearly, Radford's model represents a major shift from the conception of decision making as an individual, intellectual process to that of a social process. The decision interactions do not necessarily lead to a firm commitment. As Radford (1987) notes, "resolution usually results from many iterations through the phases over a period of time".

The exact nature of the decision interactions can vary. Churchill (1987) notes the common existence of *power* differentials between participants, and also the different types of *"decision forum"* which an organisation may employ - ranging from *participatory management* to *complete autocracy* - i.e *authority* differentials. In view of the association between important decisions and level of seniority, it is not surprising that, in the common bureaucratic model, the privilege of participation is awarded to relatively senior managers, whilst stricter controls operate at lower levels.

In the experience of the OR practitioners interviewed during this research, decision interactions are often limited to discussions between a small group of people who are closely related within an organisational structure. This may be a small group of managers of different departments. Quite often, debate will take place within a single department or problem-owning group, between a manager and his subordinates. In other situations, debate will continue at a higher level, involving a senior sponsor, and possibly managers from other departments who have more than a peripheral interest in the project.

From the preceding discussion, it should be clear that the archetypal role of 'decision maker' is a simplification of real-life roles. In general, there are a number of potential *decision participants* who are all involved in surveying their environment, and in formulating proposals for action. These decision participants include problem owners and sponsors, and their colleagues. Some or all of these people will become engaged in discussions, though the nature of these discussions will vary according to the power differentials between the participants, and the level within a bureaucratic structure at which decisions are being made. At one extreme, a manager may make unilateral commitments towards objectives, within constraints laid down by his superiors. In this case, the textbook model of a single *decision maker* is appropriate. This 'tactical' form of decision making may be regarded as a *limiting case* within the general model.

4.2.5 Conflict

Having recognised the social nature of decision making, the existence of multiple proposals, and the existence of power and authority relations, it is necessary to consider the influence of *conflict* within OR's environment. Although conflict may sometimes seem to be a consequence of an OR project, it is appropriate to view it as part of the

environment of OR work since differences in interests are almost always present (though perhaps latent) irrespective of the OR workers' conclusions. Conflict can arise through differences in the interests of any of the participants in the decision-making process. However, it seems that the exercise of executive authority, and of power, result in two levels of conflict being identifiable.

The first level of conflict is largely *within* the decision process, where powerful and interested decision participants recognise that there are differences which need to be addressed and perhaps reconciled before a decision can be made. Radford's model is helpful here, considering outcomes of decision processes as "similar to *equilibria* in game theory. They are solutions to a situation from which no participant can gain by moving, once committed, as long as the other participants do not ... these outcomes are constructed as a result of interactions between participants" (Radford, 1987, emphasis added). Conflict may be said to exist where an equilibrium, a joint agreement to act, is not easily found. However, as Bryant (1991) points out, conflict may persist in *un*stable equilibria, where participants are unhappy with the status quo, even though they cannot immediately gain by moving.

OR practitioners recognised this form of conflict to be most common between departments or functions. They agreed that "whenever you're talking about use of resources, different people have different requirements"; that different functions "obviously" have different objectives; that "there are departments ... that hate each other"; and that there are "almost always differing views". The incidence of this sort of conflict obviously depends upon the extent to which the intentions of the principal decision participants impinge upon parts of his organisation which are beyond their jurisdiction, and upon how favourably their intentions are viewed by their 'neighbours'.

The process by which this sort of conflict is normally resolved, and stable equilibria are established, is described by Radford in the following, almost comically abstract terms:

> "The penalties and disadvantages that discourage the participants from moving from an agreed outcome ... are usually contained and described in contracts and other agreements that result from the interactions [between decision participants in conflict]" (Radford, 1987).

OR practitioners' definitions of the process were more graphic:

> "lock them in a room, and let them punch each other - [*because*] that's the way businesses work";
>
> "politics, compromise, vague suggestions of promotion and, I don't know, God knows what else".

If these 'resolution' processes are not effective, a more senior manager is usually asked to intervene, often to '*arbitrate*', although, as Banbury has remarked (1968), "it is doubtful if the word "arbitration" would be appropriate under these conditions". The senior manager's role, here, is to impose a solution by means of his *authority*. Naturally, it is convenient if the sponsor of the OR project is sufficiently senior to play this role.

The second level of conflict is, largely, *beyond* the decision process i.e. between decision makers and other stakeholders. This occurs when:

(a) a decision maker, or a *coalition* of decision participants (a group whose differences of interests are small in relation to the differences between them and other persons or groups) are sufficiently powerful to be confident that their decision can be, or should be, implemented; and

(b) This decision is received unfavourably by other stakeholders i.e. persons outside the decision-making coalition who are affected in some way by the decision.

The most simple example of this form of conflict is a worker's resistance to a decision made by his departmental manager. As a matter of course, this conflict is resolved by the manager's exercise of his formal authority.

If workers persist in fighting their case, then processes of argumentation and negotiation may begin in which their interests are usually represented by a senior worker, perhaps at supervisory level, or by a union representative. Such *representatives* are not usually representative (of the workers) in the literal sense of the word: they are usually relatively experienced and senior, relatively extrovert, relatively diplomatic, and relatively happy to compromise. In any event, it is these representatives with whom the OR practitioner is most likely to be involved. Although workers and their representatives are unlikely to be invited to participate in the normal decision-making processes as a matter of course, they can influence the process by refusing to cooperate with the implementation of certain outcomes. They can play this role if, and only if, they can form a sufficiently large, well organised and powerful coalition.

OR practitioners were ambivalent in their attitudes to the form of conflict described above. On occasions, they were happy to acknowledge managers' exercise of authority as normal practice:

> Q: "If you're doing work that affects the way that other people in [the company] work .. how are their interests taken into consideration - if, indeed, they are?"
>
> A: "We would assume that the managers of that function know how the function operates - it's their job to handle any changes."

and

> ".. we're on the board's side, and we're against the unions."

On other occasions, a similar point was made, but with more sympathy:

> "virtually everything that we do affects some poor clerk somewhere - probably badly, I don't know.. "

and

> Q: ".. you're involved with work that directly affects people in the factory .. How do their requirements fit in ..?"
>
> A: "They don't normally get a look in."
>
> (later) ".. no-one had consulted them, but it had to go through because someone at all higher level, in association with some of their representatives, had said "yeah, it's okay""

Many OR practitioners feel that this form of management/worker conflict rarely impinges upon their work. One practitioner said

> "we don't normally get involved with people right down the scale .. the kind of work we get involved in won't normally affect people's jobs."

However, it was often unclear whether this 'distance' (from workers, and from conflict) was imposed on the operational researcher, or by him.

In one particular case, where an OR group operated within a service industry, the nature of the company's business was thought to insulate workers' jobs from being disturbed either by OR projects or by most other management decisions:

> "the thousands of people in [HQ] .. are moving pieces of paper with information, .. and collating information .. [W]e exist internal to that information process .. we are suppliers of information, and collators of information .. You would have to do a very very major piece of work indeed to restructure the way branches do things. I don't think that sort of thing is done here."

The subtle differences in attitudes, that are illustrated by the above examples, were discernible within the responses of individual ORers, as well as between them. My point here is

that sometimes ORers *accepted* their client organisations' ways of handling management/worker conflict as part of the context of their consultancy work. Other times, only the *existence* of the conflict was taken as given, and ORers sought to *treat* the possible resolution of conflict as an outcome of their work. I shall address OR practitioners' approaches to handling conflict in a later section.

Another potential area of conflict concerns the client organisation's responsibilities towards its *customers*, and the general public. In the case of a local government OR group, the public were considered to be the 'real' clients (intended beneficiaries of OR work) whose interests were represented by elected council members. In another case, the public were explicitly recognised as having the power to reject the organisation's policies, and therefore to influence the decision process:

> "it is a fact, universally acknowledged, that everyone hates the [companies in this industry] .. you've got to get it right first time."

4.3 Institutional Context of OR

This section contains a short discussion of OR's organisational position, and the procedures which apply to the conduct and evaluation of OR work.

The five in-house OR workers in this study all work at similar levels within their organisation. In each case, the OR manager is *two* bureaucratic levels below the board of directors, or equivalent. OR groups are positioned within a variety of management lines. The OR practices visited here are positioned within Logistics, Information Technology, Business Development, Corporate Planning and Research and Intelligence. In all these cases, ORers are not directly accountable to particular functions, but to other development/support services.

All of the practices studied in this research operate on a 'project' basis i.e. OR is *administered* (and/or sold) in discrete units called projects. However, it is clear that not all ORers' work is part of a formally designated project. Several ORers spoke of doing small pieces of work which are not documented. "Sometimes you just *do* the work", one of them commented. Another practitioner said that *most* of his work is of this type.

Projects are administered as such to make it generally easy to monitor and control OR work. Projects are also used so that clients (sponsors) make formal commitments to a piece of OR work. In practice, each project has (what are usually called) "terms of reference" (ToR), which are usually drawn up through interactions with problem owners and sponsors. These may summarise the background to the project, and specify the reasons for carrying it out, the anticipated benefits and the amount of "effort" that is to be committed by ORers. The exact details vary considerably from organisation to organisation.

One ORer said "you draw up terms of reference .. and then you forget them". Whilst this was probably only a *semi*-serious statement, it indicates that ToRs are used to provide a focus for attention during the early stages of a project. They are also used to indicate that clients have 'signed' a "psychological contract" with the OR consultants (Schein, 1969).

Only one of the practices visited in this study was *charging for individual projects*, although another was about to adopt this way of operating. Where charges are made per project, formal evaluation of the OR group's work is relatively straightforward: The group does not have to argue for its existence, but simply has to 'pay its way'. In other situations, the economic virility (and advantage) of OR is usually monitored on an annual basis. At the very least, the group needs to demonstrate that it has "recovered its costs".

This may be done on a *retrospective* basis, whereby the OR manager reports to his superiors, recounting the benefits and costs of OR project work. It may be done, at least partly, *prospectively* by the OR manager, who presents estimates of the group's forthcoming workload, and lobbies for support and adequate manpower. This may be done more than annually, so that project work can be anticipated. One group in this survey presently adopts this kind of approach on a project basis; they only undertake projects which seem likely to secure savings of at least £½ million ("or equivalent strategic benefit").

One ORer commented "I suspect payoff is being looked at increasingly closely .. I don't think that's good .." Apart from financial virility, the most common means of evaluation is via continued *project turnover* and, in particular, via "satisfied" clients *"coming back for more"*. ORers also consider informal feedback from clients as a sound means of evaluation. In one organisation visited, sponsors are asked to provide formal feedback to the OR group via a written questionnaire. The OR group can then use this information to supplement its arguments for financial viability.

The procedures described above help to measure client satisfaction and financial viability. Although ORers also evaluate their own work in terms of factors such as the "quality" of their work, and its impact, client satisfaction and financial viability appear to be the principal measures by which ORers are made accountable to their host organisation.

4.4 Summary

The social setting in which OR is practiced includes people who are *concerned* about the topic of a piece of OR work, people who have the *initiative* or the *authority* to commission OR work, and people who *participate* in the work. Much OR work

is part of a formal *project*, though work may continue beyond the project bounds.

Various client roles can be defined in reference to combinations of these characteristics. Notably, a *problem owner* is concerned, and has initiative, a *sponsor* has authority, plus sympathy with a problem owner's concerns, a *user* participates, and a *stakeholder* has concern only. Individual persons may play more than one role, whilst roles may be played by more than one person.

Problem owners and sponsors are amongst a wider group of *decision participants*. Each participant engages in intellectual processes of *theory and proposal formulation*. Participants may then *interact* before negotiating choice commitments.

Boundaries are set, to the formulation of proposals and to the nature of interaction, in the form of the objectives and constraints of senior managers, usually within a bureaucratic structure. OR work is evaluated periodically with reference to these objectives; sponsors' evaluations of project work form part of this process.

Conflict may exist between decision participants themselves, or between decision participants and other stakeholders. Conflict is usually 'resolved' by appeal to *authority*, or by the exercise of power.

Chapter 5

THE NATURE OF PROBLEMS IN O.R. PRACTICE AND METHODOLOGY

A glance at the definitions of OR which practitioners offered (chapter 3) shows that the concept of "problem" is central to their views on what their subject/activity is about. The OR literature, and that describing related consultancy fields, reveals a variety of different views on what a problem is, or could be, about; what it means to "solve" or otherwise deal with a problem; and what contribution a consultant and his "technology" might make to this process. In their study of the Organisation Development profession, McLean et al. (1982) remark "we have noted a massive variation in the usage of words like 'issue' and 'problem'". Bryant (1989) refers to "problem" as a "portmanteau" word, "simply laden with meanings".

The richness in meaning of the term "problem", both in colloquial usage and in formal expressions of OR methodology hinges on fundamental questions about the languages with which situations might be described. Faced with the same "definitional mire", Bryant begins by considering how an individual's experience, and his framing of it, may lead him to shout "Problem!" I have already prepared the way for the intervention of the OR practitioner, by describing the social context of this intervention. Using this sketch of the 'cast' as a basis, I shall try to overlay a description of problems, and their place in ORers' methodologies. I shall begin by considering the notion of *ownership* of problems, and then discuss what this means in a

decision-making environment. I shall then attempt to relate the problems encountered in the work of the ORers in this study to the ways in which problems have been described in OR literature.

5.1 Problem Ownership

In the previous chapter, I stated that "no OR ... work would be done unless (at least) one individual felt that there was some issue that people should resolve or address". OR practitioners report 'clients' approaching them and saying "we've got a problem that we'd like to discuss with you". One practitioner defined a problem as:

> "a feeling that something is wrong - that all is definitely not right with the world".

Another ORer spoke of some "hot" problems where:

> "clients are uneasy about a situation, not happy with the way things are going".

These situations "happen not infrequently". Another practitioner spoke of working to "ease people's headaches". Problems can be said to be *owned* by people because they involve experiences of *psychological trauma* (or disquiet, unease etc.). For some practitioners, trauma is a definitive feature of problems.

For other practitioners, trauma is a personal reaction to the "symptoms" of a problem. Here, symptoms are those phenomena which alert someone to the 'fact' that something is wrong. Trauma is being used to denote (perhaps to define) the existence of a problem. However, a distinction is being made between 'the problem' itself and the incidental by-product (or side effect) of it, which is trauma. This distinction was made even clearer by one practitioner who offered a variant where,

> "you've got emotional problems that are in the way of tackling the real problem" - but "the emotional thing is not there most of the time"; only "when they've got emotional problems at home, affecting their work".

The implication here is that emotional trauma signifies a problem which is 'unreal'. Eden and Sims (1979) challenge the perspective from which people speak of 'unreal' problems. They argue that

> "problems can only be the outcome of making sense of the reality the person has constructed through the use of his mental frame of reference; if after the use of his frame of reference he has some unease or dissatisfaction which he does not know how to deal with, we say he has a problem".

A supporter of this argument is Bryant, who comments that "problems have their genesis, not in the world 'out there', but rather within each one of us" (1989). A more surprising ally is Rivett (1974), who provides the following illustration:

> "If I say that a certain company has a very difficult long-term planning problem, then it is impossible for you to visit that company and to see it lying before your eyes painted red and green and making a noise like a bell when you hit it. These problems do not exist in such concrete form. The problems only exist *in our minds*" (my emphasis).

There are impressive arguments for the rooting of problems in subjective experience, but protagonists of an opposing view are conspicuous only by their absence. However, the quotations above indicate that OR practitioners in this study vary in the degree to which they acknowledge the relevance of psychological trauma to problem definition. Some practitioners may feel that personal ownership of problems is trite and rather obvious. Alternatively, they may feel that emphasis on *subjective* issues implies that problems are purely *imaginary*. I shall return to discussing the real/imaginary nature of problems later in this chapter.

So far, I have referred to problems as *negative* experiences. This is the viewpoint which was most commonly adopted by the practitioners interviewed. However, it is apparent from informal conversations with ORers that problems may often be construed as *"opportunities"*. Here, clients have a niggling feeling that their situation could be better, in some sense.

Clients' problems and ORers' problems

For a concept so central to OR methodology, there is a surprising ambiguity in the use of the term "problem" by OR practitioners. Problems appear both as 'things' which are attached to (or belong to) clients, and also as 'things' which the consultants themselves must directly face and manage. Some practitioners in the survey tended to emphasise one meaning rather than the other, but all of them used both meanings, often interchangeably. Where appropriate, I shall try to distinguish between these different usages.

5.2 Decision Making

The context for this disquiet is the process of decision making, and the exercise of executive responsibility, that was discussed in the previous chapter. This is made clear in ORers' definitions of problems as situations:

> "where a person is not in a position to make a decision, for whatever reason".

> "A lot of problems, at the moment, are competitors' actions, and 'what the hell are we going to do about it?'"

The relationship between problems and decisions can vary. Sometimes clients' problems may wish to be able to "monitor decisions already made". One practitioner considered that clients need "to understand their problems *in order that* they can make their decisions" (my emphasis).

ORers in this study *conceive* problems in terms of various 'stages' of an idealised decision process. Problems may be concerned with one or more of the following:

1. Understanding complex situations;

2. Understanding the nature of choice of actions;

3. Making choices.

This idealised process is similar to that of Simon (1960), which consists of intelligence (data gathering), design and choice. However, I have used Radford's modified version of this model in the previous chapter, because it seemed to fit the kind of organisational life that ORers described in this study. In this context, the process above actually describes individual managers' formulation of theories and proposals for action. It does *not* describe the entire decision process, although the two processes are similar if a manager is making decisions in which he does not need to interact with his managerial colleagues or his superiors, and implementing decisions in which he does not need to interact with his colleagues or subordinates.

<u>It seems that OR practitioners conceive problems to be imbedded in individual managers' processes of theory and proposal formulation</u>

Problem *owners* may not be *conscious* of the problematic nature of these processes, or may choose not to recognise it. Instead, they may sincerely believe that problems are 'out there' in the situations which face them. Managers who acknowledge their intellectual or social processes to be problematic may invite help from consultants such as Development Training professionals. It is unusual for ORers to be 'used' in this way. More commonly, the decision process elements of problems are recognised by ORers, but their

clients' attention is focussed on complex situations with which they must cope.

5.3 Coping with Complex Situations

The most common location for problems, as described by the ORers interviewed in this study, is in the *lack of understanding about complex situations*. This is the first stage in the formulation process described above, and corresponds to the *formulation of theories*. However, managers are always concerned with understanding situations so that they can exercise control over them, so difficulties in formulating *theories* necessarily implies difficulties with the corresponding *proposals*.

Problems are frequently of "plain ignorance" of the situations which clients are facing. This may be expressed as:

> "Tell us what you can about this situation".

This need not imply that clients are mentally deficient; rather that the situations they face are often *complex*, and *difficult to comprehend* without the support of professional helpers. One problematic situation was discussed in an interview in the following terms:

> "there was no question of ignorance ..[but].. they needed a set of *rules*, telling them what to do in certain situations.."
>
> "Because it was *complex*?"
>
> ".. *Exactly*, yes."

The OR Society's journal carried a definition of OR (until 1984) which referred to *"problems arising in the direction and management of large systems of men, machines, materials and money"*. [This generalisation is suitable for manufacturing (and similar) industries. In the cases of service industries, one might speak of 'large systems of man, services and

money'.] The phrase "large systems" is relevant to this discussion of complexity. "System" refers to something which has a set of interrelated parts; a "large" system, therefore, has a large set of interrelated parts. If managers are concerned with "systems" which have large numbers of parts, and large numbers of interrelationships, we can say that they are facing *complexity*.

The name "operational research" encourages a concern with complexity. Stoller (1964) defines OR as "the study of 'operations'. An operation consists of an activity (or complex of activities) occurring in a man-machine system" (see also Miser, 1976). White (1975) refers to "the object system", about which managers need to make decisions. For many ORers, operational research must, by definition, be concerned with research into complex systems.

From interview data, the following four threads can be discerned in OR practitioners' attitudes to problems' roots in complex systems:

1. Need for understanding the workings of a complex object system i.e. "ignorance" - see above;

2. Diagnosing a fault that has occurred in the workings of a complex object system

> "A problem may be defined in terms of a tangible *symptom* ..";

3. Preferred design of a complex working system

> ".. or in terms of a process to *prevent* a symptom";

4. Articulating the process of decision with respect to a complex object system

> "complexity .. in terms of the number of *options*. The difficulty is just simply in the *mass* of information, and trying to condense it down into something which gives the bloke a few sensible ideas on how to improve things".

In the OR project cases that were described by the practitioners in this research, the most common form of problematic "object system" was one defined in terms of *machines, materials and manpower*. Such cases were found to be particularly common in industries concerned with manufacturing and distribution of tangible products.

There seems to be an increasing incidence of problems defined in terms of financial aspects of the object system. This is mainly due to moves towards organisational structures consisting of relatively autonomous management units (eg profit centres), and towards 'contracting out' of specialised services, which have occurred in many industries during the 1980's. This trend can be discerned from anecdotal data on the development of the OR profession, although it was less clearly evident from the formal fieldwork.

5.4 Contemporary Debate on the Nature of Problems

The nature of problems has been the subject of ongoing, and prominent, debate in and around the OR community in the UK, particularly in academic circles during the 1970s and 1980s, and into the 1990s. The purposes of the following sections are to *contribute* to this debate, and to use the *language* of the debate to reach a deeper understanding of the problems encountered by OR practitioners in this research.

5.4.1 Technical .. human / political problems

Cropper (1987) draws a distinction between *technical* problems, whose features are inanimate, and *political* problems. A political problem occurs when a technical problem is

"overtaken by events somewhat" - events of a "social and political nature". The technical problem is thus subsumed beneath the political problem. Similar aspects of problematic situations have been discussed using different terms, such as *"observable"* (eg Totman, 1966), *"mechanical"* (eg Jackson and Keys, 1984), *"modellable"* (eg Ackoff, 1962, Bishop, 1972), and *"well-structured"* (eg Rosenhead, 1989b). Turner (1981) distinguishes between "quantifiable" and "politics" aspects of problems.

In their analysis of "problem contexts", and the suitability of various methodologies, Jackson and Keys (1984) use a "mechanical..systemic" construct. In this relatively sophisticated analysis, three of the four elements of "systemicity" are *non-observability*, dominance of *behavioural aspects*, and the existence of *purposeful* parts in a system whose structure is open to change. Jackson and Keys consider OR to be appropriate to mechanical problem 'types'.

White's (1975) book on OR methodology makes a basic distinction between "the subject system" which makes decision and solves problems, and "the object system", about which decisions are made, *and in which problems are rooted.* Here, problem situations are portrayed as consisting of two levels (see figure 3): the inner level is a (mechanical) system of objects; the outer level is a system of (human) subjects - decision-makers, who have responsibility for managing the object system.

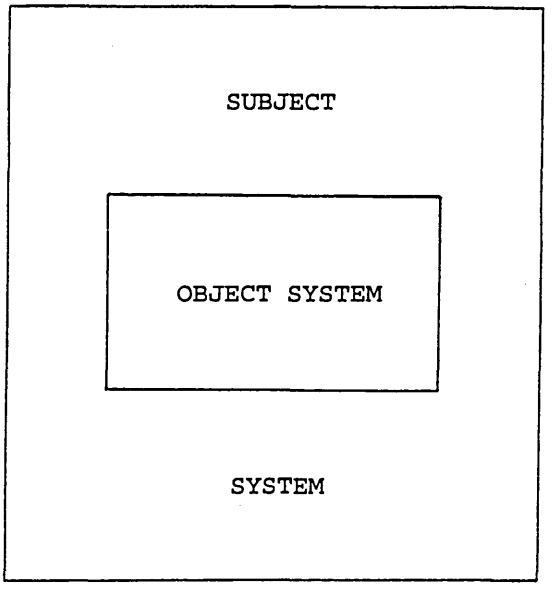


Figure 3

The OR practitioners in this survey tended to use *dualisms* such as technical..human when describing problems. A similar distinction is often made between *"theoretical"* problems and *"practical"* problems. One practitioner said that "practical constraints are pushed aside while we're doing the analysis". These practical constraints include "political" factors such as industrial relations, directions from senior management etc. This practitioner described one project as follows:

> "We've produced a theoretical answer to the problem. Now we're working out how it can be implemented in a practical manner, given the practical constraints of the organisation. We're actually helping them develop an implementation strategy, which is quite a new area".

From this quotation, it is clear that this ORers' experience does not usually include the human/political - or "implementation" - issues. Another practitioner also used the theoretical..practical distinction but took a broader view, recognising that "time constraints", "resource constraints" and "political constraints" are all *essentially*

part of 'the problem'. He considered it unwise to take a narrower view, saying "I don't think OR is into 'optimising'".

A related issue concerns the notion of an "OR problem". Several ORers in this study referred to "problems of an analytical nature"; situations which "you would expect to be able to improve (if not solve) by using an ordered, mathematical type of approach". It seems that particular kinds of problems are brought to the attention of OR practitioners. This does not mean that 'OR problems' *only* have technical, quantifiable components. It is clear, from the above discussion, that this is not the case. However, many ORers recognised that problems have a technical/mechanical *core*: one said that "there is nearly always a quantifiable part - always, I think".

An 'OR problem' may often be "a subproblem of the total problem, that is supposed to be amenable to an OR approach" (Lagergren, 1981). In other words, there may be a wider set of concerns which are not actually offered to ORers as 'their' problem. One practitioner considered OR problems to have a place within a hierarchy: "all problems are part of the metaproblem of 'how to make more profit for [the company]', or whatever".

The degree to which human / political issues are considered to be part of clients' problems varies from practitioner to practitioner, and from project to project. As shown in figure 4, there are three levels at which human and political issues impinge on problem situations which are confronted by ORers:

(i) *Behavioural* issues - including manpower issues, ergonomics, and industrial relations issues;

(ii) *Decision-making* issues - relationships between the principal decision participants;

(iii) *Consultancy* issues - relationships between the ORer and the many other actors described in the previous chapter;

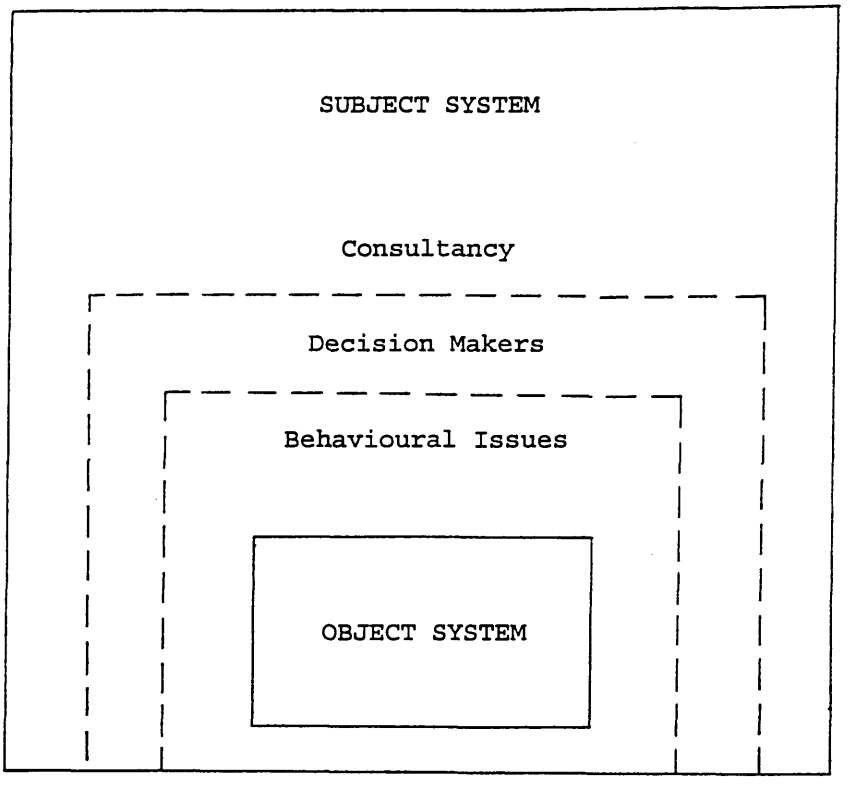


Figure 4

The distinction between (i) and (ii) is used by Jackson and Keys' in their taxonomy of problem situations. I have already noted that their mechanical..systemic dimension of problems includes *behavioural* issues. However, these are behavioural issues which may dominate the *'object'* system - i.e. they are concerned with manpower issues, industrial relations, or perhaps with the behaviour of consumers, competitors etc. A second, distinct, dimension - is used to describe the *"nature of decision-makers"* (Jackson and Keys, 1984, emphasis added). The "complex situations" discussed in section 5.3, above, are distinguished from the decision makers and problem owners (sections 5.1, 5.2) who are in the business of *coping* with these situations. However, this distinction between the two dimensions is blurred by Jackson (1990), who refers to "participants" instead of "decision makers".

It could be argued that Jackson and Keys' two-dimensional classification shows an awareness of the human aspects of 'object' systems, and an awareness that problems vary in the degree to which they are dominated by human factors. Alternatively, it could be argued that, in the realm of human/political issues, there are some which are regarded as relevant to the *subject* system, whereas others are merely *"object"*. This attitude has clear political and moral implications for OR practitioners.

Cropper makes a further distinction, within "political" problems (or political aspects of problems), which concerns the operational researcher's relationships with the political actors. An *egocentric* attitude to political problems consists in a consultant's devotion to the concerns of a single client, in the midst of political events. A *sociocentric* attitude is one where the "locus of concern is [thought to be] diffuse" (Cropper, 1987), and a consultant considers a whole organisation (or even parts of many organisations) to be "the client".

In the previous chapter, I said that ORers are "keen to identify an individual as the problem owner, wherever possible". This "egocentric" attitude is encouraged (or even required) in bureaucracies. It is also a convenient attitude, since an 'OR problem' may be defined in such a way that political issues are only considered from one perspective. This is consistent with the view (expressed in 5.2) that ORers conceive problems to be imbedded in individual managers' processes of theory and proposal formulation. With reference to Radford's model of decision making, an egocentric attitude to political problems consists in helping a single decision participant to formulate proposals ("strategic" analysis - Radford, 1987) *and* to 'fight' for these proposals in forthcoming decision interactions ("tactical" analysis).

Clients may also encourage this kind of approach from consultants. There are, undoubtedly, some political concerns

which clients considered to be solely their domain, and not legitimate concerns for the operational researcher.

Consultancy issues are major concerns for ORers - and also for their clients. The nature of these issues, and the ways in which they are handled, is discussed at length in chapter 8. These issues are often referred to as "client relations" or "implementation" issues.

5.4.2 Uncertainty

Friend and Hickling (1987) define uncertainty in decision making as situations "where doubts arise over the choice of *assumptions* on which the designing or comparing of alternatives should proceed". They divide uncertainty into three types:

(i) pertaining to the *working environment* (UE);

(ii) pertaining to *related decision fields* (UR);

(iii) pertaining to *values* (UV).

I shall consider each of these types of uncertainty, in turn.

Uncertainty pertaining to the working environment

This type of uncertainty is very relevant to the problems encountered in OR practice. In the sections above, problems are characterised by the *need for decision participants to get to grips with the workings of a complex 'object system'*. Common questions such as "what's really going on?", "how are we doing?" are asked out of UE; they are questions of ignorance (see 5.3). Friend (1989) notes that UE "can be dealt with by responses of a relatively *technical* nature". This view is consistent with the picture of

technical/mechanical issues at the *core* of problems confronted by ORers.

Uncertainty pertaining to related decision fields

Uncertainty regarding the breadth of perspective that is taken of 'the problem' is explicitly considered by ORers in their notions of hard and soft "constraints", and of problem "boundaries". Where this uncertainty relates to fields within the jurisdiction of the problem owner and/or sponsor, it is considered to be a feature of the problematic object system. One practitioner commented that he works in "a very functionalised industry - so we don't get much crossing boundaries".

Uncertainty regarding behaviour and proposals of other (potential) decision participants is also treated this way, as far as possible, though this only applies to related decisions which result in changes to the object system *during* the problem-owner and ORers' attempts to comprehend that system and to articulate proposals for the management of it. One OR practitioner in this study explained:

> "during the course of the project, we learned that other people elsewhere were making decisions, and that what you *initially* thought was the 'hub' of things has to fit in with the rest of life".

I have portrayed the decision context of OR intervention as a two-stage process in which a problem owner seeks to establish proposals and then, if necessary, interacts with with other actors who have been doing similarly. I found no evidence that OR practitioners regarded the incidence of conflicting proposals (at this second stage) to be part of 'the problem'.

Uncertainty pertaining to values

Although objectives may need to be clarified, or policy guidance sought, these parameters of the problem are often required (by ORers) *so that* they can get on with helping to

tackle the problem. It seems that UV is not usually treated as a major source of the decision-related trauma that actually defines the existence of a problem. However, attitudes vary between OR practitioners.

The ORer from the "very functionalised industry" said that "the hardest thing is getting down what they want you to *do* .. agreeing where the boundaries are". Objectives are sought at the beginning of an OR project. Another practitioner considered this to be a naive attitude, arguing that sometimes "a client only knows what he wants when he's had it".

One OR worker who considered himself to be involved with "strategic" problems, *did* regard reflection upon guiding values as a significant part of problem handling. He said:

> "It's not something to be asked once, at the top level .. It sort of permeates everything. .. I don't think we'd be interested in doing a piece of work with too many 'givens'".

This suggests that the inclusion of UV in problem definition is *partly* a matter of choice for the practitioner. However, this ORer recognised that in a bureaucracy, "there probably won't be much opportunity to question the objectives from higher up". Ultimately, guiding values are established and communicated within a hierarchy, and the incidence of competing values is not considered to be a *legitimate* feature of OR problems. Another ORer explained:

> "the business has certain objectives, and we are here to help the business to run better. Yes, we get disillusioned about what goes on from time to time".

The experiences of a local government OR worker suggest that the significance of UV can also vary considerably between projects: in his work, some problems had "a specific remit saying "Do this!"", whereas others were more loosely defined.

5.4.3 The Gap mentality

Checkland (1981) caricatures a common approach to problem definition whereby a problem is "any situation in which there is perceived to be a mismatch between 'what is' and what might or could or should be". I shall call this approach the 'gap' mentality.

This approach suggests some influence by developments in cognitive science during the late 1950's, which led to a view of problems in terms of the difference between what a decision maker has, and what he wants. "A person is confronted with a problem when he wants something and does not know immediately what series of actions he can perform to get it" (Newell and Simon, 1972). Festinger (1957) refers to "cognitive dissonance", which he defines as "nonfitting relations among cognitions" and as "psychological discomfort". These ideas are relevant to the notion of problems as psychological trauma (see 5.1, above).

The 'gap' approach is discernible in OR literature in what Woolley and Pidd (1981) call the "checklist" approach to problems (and their formulation). Here, problems are regarded as "failures, breakdowns, things gone wrong, or deviations from a standard". This kind of problem definition requires both the standard and the deviation to be specified. From the discussion in the previous section, it seems that some ORers would find this approach to be unrealistic, unworkable, or uninteresting.

Rosenhead (1989b) associates "tame" problems (Rittel and Webber, 1973), of finding the means to a given end, with "tactical" problems. This is largely consistent with the strategic/tactical distinction as discussed in the previous chapter: if 'ends' are *given* by senior management, then there is little need for extensive interaction between junior decision makers. *Some* of the (tactical) problems encountered by ORers in this study are of this kind. One practitioner

referred to malfunction of an industrial process as something that would be, or cause, or constitute, a problem. Another described a 'type' of problem where someone is "not quite sure how to get from one end on the process to the other".

However, in the cases cited above, the 'here' and 'there' states refer to a mechanical process or procedure for which the problem owner has responsibility. These are specific project cases. In general, problems are defined in terms of decision processes, in which client managers at *all* levels are able to use *discretion*. It is the business of formulating both theories ("what is") and proposals ("what might or could or should be") for coping with complex systems which gives rise to psychological trauma.

A slightly different use of 'gap' definitions is used in one organisation in which the OR group does not carry out a project unless its estimated benefits are over £½ million "or equivalent strategic benefit". Such problems are defined as *opportunities* to create a better future. The money 'gap' is used to *evaluate* the potential future. It does not, however, specify the *nature* of this future, in such a way that only the means of achieving this need to be calculated.

5.4.4 Unitary, pluralist and coercive problem contexts

This section is closely related to the discussions in the previous chapter, and in section 5.2 above, about the social nature of the decision-making context of OR, and also to the sub-section dealing with guiding values.

The psychological trauma which defines the existence of a problem may be shared by a coalition of problem owners who jointly struggle to comprehend a complex object system. However, their perceptions are all imperfect and idiosyncratic, so they may have different *theories* about 'the way the world is'. They also hold different values, and may therefore have different *proposals* for 'the way the world should be'. It is possible that different individuals would identify different problems (or perhaps no problem at all) in the 'same' situation (Eden and Sims, 1979, Bryant, 1989).

In the OR practices studied in this research, different viewpoints are considered to be part of 'the problem' if the persons concerned are able to form a coalition which is sufficiently powerful to influence the principal decision makers' activities. In other words, competing values are part of 'the problem' if and only if the normal organisational procedures for dealing with conflict are unable to protect the problem owner and/or sponsor from being disturbed by the incidence of these values. Rather than values alone being regarded as parameters in problem definition, it is a compound of *values* and *power*. Such power is invested in individuals who have formal authority within the client organisation. A specific example of this involves working parties; here, ORers have "many different needs and viewpoints" to consider relevant to problem definition. Other groups may derive power from their ability to disrupt or block the implementation of unfavourable policies.

There will be situations where the discrepancies between various stakeholders' values (and beliefs) are great, and

situations where they are relatively small. Jackson and Keys (1984) use three categories, unitary, pluralist, and coercive, to describe three 'types' of problem context. A *unitary* context is one where all values and beliefs are aligned. A *pluralist* context is one where there are multiple perceptions, or constructions, of 'the problem'. Here it is hoped that processes of learning and analysis can lead all parties to commit themselves to a single package of theories and proposals concerning the situation. A *coercive* context is one where multiple viewpoints exist, and where these are sufficiently different that any cohesion, or commitment to joint action, can only be achieved "by the exercise of power and by domination" (Jackson and Keys, 1984). Jackson and Keys consider OR to be appropriate to unitary contexts.

The previous chapter showed that conflict is commonplace in ORers' environments, and that some stakeholders "don't get a look in". In other words, the social context is invariably coercive. However, *problems* are defined, by ORers, such that the only relevant viewpoints are those of a problem-owning coalition and of senior managers. Such problem 'contexts' vary between unitary and pluralist. The word "context" suggests that problematic situations are thought to *define themselves*, rather than to be defined by an OR consultant. However, the different attitudes to value uncertainty suggest that problem parameters are *taken by* consultants, rather than *given to* them.

Ackoff's notion of a problem goes beyond that which is (subjectively) owned by a single decision participant, as a result of personal trauma and uncertainty. He considers a problem to be a situation encountered by a *consultant* whereby "[t]he set of decision makers and their problems form *the problem*" (Keys, 1984, original emphasis, after Ackoff, 1962). This definition is appropriate for the ORers in this study, although "decision makers" must be interpreted to mean those who have authority or power to make decisions.

The ORers in this study would, like Ackoff, like to improve the quality of life of more people than merely the problem owner and sponsor. However, differing perspectives are not regarded as an aspect of *"the problem"* which concerns them *as* operational researchers; instead they are a personal issue which *may* concern them *as* people / citizens / consultants etc. Operational research (*as such*) is used to help with clients' problems. Beyond this is the domain of personal morals and consultancy ethics.

5.4.5 Objectivity .. subjectivity

The section above has focussed upon plural *values*. However, decision participants' idiosyncratic definition of situations, and therefore identification of problems raises questions about what constitutes a *truthful* description of a problematic situation.

Eden and Sims (1979) claimed that the "underlying paradigm guiding OR practice" viewed a problem as:

> "an objective reality, a system of interacting variables that as a consequence of manipulation could be made to behave differently".

They argued that problems are *subjectively* owned, based on personal interpretation of events. Checkland (1981) utilises a similarly "soft" approach. He argues that he does not "search for 'root definitions' [of problematic situations] as if they were somehow *there* in the problem situation but obscured. Checkland simply *makes up* some root definitions which might be 'relevant'" (Checkland, 1985, emphases added).

OR workers in this study considered problems to have a 'technical', possibly observable core. However, it is in the *multi-subjective* attempts to manage this core that problems are found. Problems are seen as elusive; one practitioner explained that:

> "sometimes, in the process of investigating a problem, you may find that there's not a problem to investigate".

At least one (adequately powerful) traumatised *subject* is required to define the existence of a problem.

Cropper argues that even if a problem is recognised to have a human/political nature, it may be considered (by an OR practitioner) either as "a single space within which there may be a number of viewpoints" or as a complex where "there are as many spaces as there are viewpoints and the spaces may not be commensurable" (Cropper, 1987). In the first case, differing subjectivities are thought to be due to differences in *perception*; in the second, they are due to differences in *construction*. OR practitioners in this study tend towards the first viewpoint: where organisational actors cannot agree how to define a situation, it is because their normal human limitations, along with their different personalities, backgrounds and position within the organisation, *prevent them from perceiving "the whole problem"* - or encourage them to *choose* a narrower perspective.

If an operational researcher adopts an *egocentric* attitude, focussing on a *single* client, then it is natural (if not necessarily logical) that only a single viewpoint should be considered necessary and relevant for defining the problem. The *problem, therefore, exists, independently of the differing subjectivities* (in terms of values or perception). Paradoxically, a problem defined by an individual subject may be regarded as objective.

In the methodologies of the practitioners interviewed during this research, a problem *exists* if (and only if) one or more persons, with sufficient authority or power, believes a problem to exist. The *nature* of the problem is based on a social 'product' of the subjective problems perceived by these persons.

The need for projects to be commissioned by a problem-owner (or someone other than the OR practitioner) suggests that an ORer's definition would be insufficient to define the existence of a suitable 'problem' for OR work. However, OR groups may sometimes sponsor their own speculative research in the hope that their problem definition may be adopted by someone else at a later date:

> "If *we* perceive a problem, maybe an unstated one, or one that someone isn't sure that they've got, we can go in there and spend a bit of time showing this person that things are not as wonderful as they might be".

Operational researchers have *power*, as respected organisational actors, to influence situations, so the relevant social product of subjective problems reflects their perceptions, as well as those of clients. Furthermore, an ORer must "seek a redefinition of the problem in such a way that it makes sense to himself" (Eden and Sims, 1979). As one OR worker put it:

> "we wouldn't simply accept the parameters that the client trotted out".

Consequently, the ORer will actually be concerned with a problem which is re-defined, based on his perception of the social product defined above.

If this dynamic model of problem definition is expanded to reflect the fact that *each* stakeholder is continually redefining the situation in knowledge of the perceptions of others, we can see how complicated the process of problem definition really is. Furthermore, since most OR practitioners are devoted to either a single problem-owner or a small coalition of problem owners at managerial level, the social and intellectual processes will reflect this asymmetry of power and partisanship. The dynamics of problem definition will be discussed in the following section.

5.5 Problem Dynamics

There are a number of features of problems which contribute to a *dynamic* nature. Many of these features are related to the decision-making (subject) system. Sometimes, problem dynamics may be simply due to changes in the *information* that clients offer: one practitioner described the emergence of 'new' information in one project:

> "they'd never think to tell you this, and it's the sort of thing you'd never think to ask .. and you feel like saying 'why the bloody hell didn't you tell us that before!', but you say 'Oh, that's interesting. I'll make use of that".

On other occasions, problem owners have better reasons for redefining problems. Often, decisions made in related areas can influence the situation (see UR, section 5.4.2). Practitioners refer to situations where "someone's moved the goalposts". This may also happen as a result of managers reflecting upon their *preferences* with regard to a particular problem area. This may be manifest as directions from senior management, or as changes in decision area boundaries, planning deadlines etc. Problems may be conceived, not in terms of the making of one-off decisions, but in terms of *planning* i.e. anticipatory decision making.

Most changes in problem definition are "political" changes. In contrast, "the *structure* [i.e. the object elements] of situations doesn't change very much". Friend and Hickling (1987) have an interesting contribution to make to this discussion: in their Strategic Choice approach, *subjectively defined "decision areas" are the fundamental units of concern and analysis*, rather than complex object systems. Such areas can be redefined as often as necessary; there is no need for "last minute scrambling" by consultants.

5.6 Summary

In OR methodology, problems consist in a decision participant's *unease* about his/her capacity to formulate *theories and proposals* for action. This is largely due to difficulties in *comprehending* a *complex object system*, or in articulating *action* options.

Problems also include *social* and political aspects. A problem owner may experience uncertainty about other decision participants' and stakeholders' intentions, or about his/her response to their actions. A problem's definition reflects authority and power relations.

Problems are *dynamic*, being redefined as decision participants learn about their environment and about the nature of their decisions.

OR practitioners contribute to problem definition as influential social actors. In addition, they have their own concerns in relations to their clients' processes, or in relation to the impact of their contribution as consultants.

Chapter 6

PROBLEM-HELPING CONSULTANCY

This chapter is a companion to chapter 5, which discussed the *nature* of problems. The present chapter is concerned with the ways in which operational research constitutes a form of *problem-helping consultancy* - i.e. the ways in which ORers help to bring about the solution of problems. With reference to the pyramidal model (see chapter 3), it is concerned with the three-way relationship between consultants, clients and problems. This chapter plays, therefore, a vital part in the process of building up an overall picture of OR practice and methodology.

I shall begin by considering how people might attempt to handle problems if they did *not* make use of problem-solving consultants. The next section is based on chapter 5, and is concerned with the particular *'solution'* processes which logically correspond to the types of problems that are encountered in OR.

The third section of this chapter discusses, in very *broad* terms, the nature of the consulting *relationship* between ORers and their clients. The fourth, *major*, section is concerned with the *ways in which OR practitioners contribute* to clients problem-handling processes. Finally, I shall consider ORers' contributions from the perspective of their *behaviour* - i.e. looking at those things which are the focus of ORers' attention.

This multidimensional approach to describing the nature of problem-solving consultancy is unusual. It is not unique, however. For instance, Tichy and Hornstein (1974) use the

following dimensions to describe the approaches of various kinds of "change agent":

(i) "primary focus or target for change";
(ii) "leverage point from which pressure is applied" (within organisation? at top?);
(iii) "relationship with the system undergoing change" (force, advice, collaborator etc.);
(iv) "how they diagnose a system";
(v) "variables they attempt to change";
(vi) "change techniques employed";
(vii) "criteria used to measure organizational success".

Whilst neither Tichy's language nor the exact categories used are suitable for my purposes in this chapter, it suggests that a single dimension may not be adequate for describing problem-solving consultancy.

Many authors in OR and related fields have attempted to describe or classify various types of consultants (eg Eilon, 1975, Cropper, 1984, Bryant, 1989). Where possible, I shall use the *frameworks* that that have been used in previous work, and refer to the *results* of previous analyses, in order to contribute to contemporary debate on the nature of problem-solving consultancy. Throughout this chapter, I shall attempt to heighten understanding of the nature of OR practice by making comparisons between OR and other consulting professions.

6.1 Processes of Problem-Handling in Organisations

Before examining the nature of the contribution made by ORers as problem-solving consultants, it is helpful first to look at the way in which client organisations might handle 'problems' if they did not use a consultant to help. We have already looked, at length, at the social processes of decision making in which problems are experienced. As clients were not

studied in this research, I have only a small amount of anecdotal empirical data on clients' problem-handling processes, so much of this section is based on theories of other scientists who have studied this aspect of organisational life - theories which are consistent with chapter 4, on the social and organisational context of OR.

In chapter 5, we saw that, in most cases, problems owned by ORers' clients have, at their core, (part of) their 'business' i.e. the object system that is the focus of their daily endeavour. If this is the case, then they are already engaged in 'issue-handling' processes: *intellectual* processes of inquiry which lead towards theories about their business world; *social* processes of conversation, negotiation and argumentation which lead towards implementation of some course of action.

It is unwise to assume, just because OR work is administered on a 'project' basis, that potential clients' own problem-handling occur in discrete 'chunks' of activity. Weick (1983) suggests that managerial thought is not "visible in the form of long reflective episodes"; managers do not do their thinking "at home, on airplanes, in the john, on weekends". It is possible that managers tackle their own 'problems' by acting "more thinkingly".

Clients may *conceive* of their problem-handling processes as *intellectual* processes or as *social* processes. If, as Weick and Bryant (1988, 1989) claim, problem handling is an integral part of normal managerial activity, then clients' problem-handling processes may well take a similar shape to the processes in which problems are experienced. For instance, for Bryant (1989, after Friend and Hickling, 1987), the problem-handling process can be regarded as an ongoing process involving six phases - or modes of operating: scanning, shaping, designing, comparing, choosing, doing; this cycle describes what is essentially a *decision* process.

However, if an *individual* owns a problem, it is possible that he may regard problem handling as an *intellectual* process which he undertakes *so that* he may then resume the normal social processes of organisational life.

Clients' conceptions of the nature of problem-handling are relevant because they affect their choice and expectations of potential problem helpers.

6.2 Solution of Problems in OR Practice

In the last chapter, I described the problems encountered by operational researchers as being embedded in a social decision process. More specifically, they are embedded in an individual manager's processes of theory and proposal formulation, which form a *part* of this decision process. The processes of problem handling which correspond to the 'types' of problems described in the last chapter are, therefore, *primarily individual* experiences (on the clients' part), which culminate in a single decision participant being better equipped to participate in processes of negotiated action. In this section, I shall briefly discuss these processes of problem handling. This should help us to understand the orientation and aims of OR practitioners, and their *relevance* to clients' problem-handling experiences.

Problem psychology

From this perspective, problems are solved if and when *clients no longer feel a sense of unease*, or experience trauma, as they attempt to participate in decision processes. Eden's notion of *problem finishing* is relevant here: a problem is finished when an "unknown worry" becomes a "conscious dream" (Eden, 1987). Problem finishing "is related not to an analysis of the situation but to the owners of the problem". Consultants concerned with problem 'solving' of this kind must

"track the psychological state" of each decision participant who is considered relevant to the definition of the problem.

Problems rooted in a complex object system

Where clients' problems are concerned with systems of men, materials, machines, services and money, whose numbers of parameters and relationships make the system complex, solution requires a new and *enhanced understanding of this system.* This understanding may be reached through clear explanation, through additional or special information, or through a description of the system from a fresh perspective. Understanding needs to be reached by a single manager only, in many cases.

Human, political and pluralist aspects of problems

'Technical' problems may be solved by "a theory to explain the observed characteristics of the system under study" (Totman, 1966), and perhaps an explanation of how certain actions would lead to desired outcomes. If problems have a *behavioural* element, concerning industrial relations, consumers, competitors etc., theories about the system are open to different *interpretations* of behaviour.

Given the *egocentric* approach adopted by ORers (in this study), the problem owner's interpretation is likely to be accepted. If a sociocentric perspective is adopted, as with some strategic decisions and working parties, solution requires successful *'negotiation'* (or imposition) of shared understanding and commitment to action. ORers tend to view this as a separate problem - 'the problem of implementation'. ORers in this study often spoke of a two-stage process in which *theoretical* problems are solved first, then *practical* problems. This is the opposite approach from that of "problem finishing".

Uncertainty and dynamics

The major type of uncertainty in problems in OR practice is uncertainty pertaining to the environment (UE). According to Friend and Hickling (1987), this is a situation where "we need more *information*" (emphasis added), and progress is made with surveys, analysis and modelling.

Where UR (related decisions) forms a large part of a problem, "we need more coordination", and progress can be made through *liaison* and a *broad* approach to planning. This applies to sociocentric problems. Where UR is concerned with the *"boundaries"* of the problem, decision participants need clear *delineation* of their responsibilities. Where UR is concerned with the *dynamic* aspect of problems, solution requires a *flexible, iterative* process which can respond to changes. One ORer criticised his organisation's IT group, saying "they don't operate with the customer properly. They take the problem away, and produce a solution, and find it's not right" (see also Tomlinson, 1980).

Where UV (values) is significant, "we need clearer objectives"(Friend and Hickling), and progress can be made through policy guidance, or by getting all 'concerned' people involved in the solution process. The most common type of UV in the problems described by ORers in this study is that requiring *reflection* upon objectives, and occasionally guidance from 'above' (although not usually in the Christian supernaturalist sense!).

6.3 The Nature of Consulting Relationships

I am concerned, in this section, with the professional relationship between clients and consultants which defines boundaries to the problem-helping activities of consultants.

Consulting relationships can be distinguished as *service* or *partnership*, though these terms should be used to describe a spectrum of approaches, rather than two ideal types of approach. Service relationships are ones in which "the helper effectively *takes over* from the problem owner" all or part of the problem-handling process (Bryant, 1989, emphasis added). Alternatively, partnership between ORers and clients involves these parties "working through some part or parts of the problem-handling process in collaboration" (Bryant).

Consulting relationships are developed through negotiations between clients and consultants. Each will prefer a relationship which is appropriate to his conception of the problem: If clients view the problem as being 'out there' - either in the market place, or somewhere else within their own organisation - then they may want to choose between service and partnership according to how much input they want to make into the problem-handling process, how personally attached they are to the problem, how much they trust the consultant, how much time they've got to spare etc. Consultants may choose a service relationship, for similar sorts of reasons. If, however, the consultant or client view the problem as being concerned with *client processes* in some way, they must recognise that the consultant cannot be very useful unless he is *involved* with the client i.e. working in "collaboration".

Almost all the operational researchers in this study spoke about the importance of working in partnership with their clients. For instance, one practitioner said:

> "I'm certainly a believer in working at it with the client, not simply taking the problem away. That would involve more meetings with the client .."

The need for collaborative working was thought to emanate from the dynamic nature of problems. In order to understand the changing nature of a problem, consultants feel they must have an ongoing involvement with the client during the problem-solving process, because the client is the person who is best

able to define what the problem 'is'. However, this does not necessarily mean that ORers are collaborative in practice.

The need for collaboration does not extend to other members of the 'cast'. I have defined the sponsor as someone who commissions some OR work. This person has, by definition, a service relationship with the consultant, unless he/she is also a problem owner.

Partnership has often been cited as an *ideal* for OR work. Tomlinson has often emphasised the importance of working in this way, so that OR is something that is done *with*, not to, or for, a client (Tomlinson, 1974). On the earliest occasions on which the social/consultancy nature of OR was recognised, a 'service' relationship was usually assumed. Churchman and Schainblatt (1965) described four 'positions' or types of relationship between manager and researcher. They encouraged the adoption of a position of "mutual understanding" which suggests an interest in collaborative working. Despite this, their section on the manager understanding the researcher betrays an attitude whereby the researcher seeks to tell of the results of his research, which he has undertaken as a service to the client. Their section on the researcher understanding the manager emphasises a "naive" (Churchman and Schainblatt) approach whereby the researcher tries to understand the client's mindset *so* that he can more convincingly communicate his results.

Our understanding of the approach of operational researchers can be helped by comparison with the approaches of other problem-helping consultants. Eilon's 'seven faces of research' (Eilon, 1975) include some which seem to operate as a service ('chronicler', 'puzzler', 'empiricist', and 'classifier'), and others which involve some sort of partnership ('dialectician', 'iconoclast', and 'change-agent').

The growth of 'soft' OR since the late 1970s has encouraged ORers to think of their consulting relationship as a partnership. For soft ORers, problems are located in the world 'constructed' by their clients. Problem-helping must, therefore, be a fundamentally collaborative experience. Eden and Sims (1979) describe this as an "empathetic" paradigm. This does not mean, however, that soft ORers cannot make *any* progress towards solution in isolation from their clients.

The work and writings of organisation development (OD) consultants are quite insightful. In employing an OD consultant, clients are signalling their belief that their own social processes are, in some sense, problematic. Schein (1969) writes of "joint diagnosis", and collaboration is clearly an ideal for OD consultants. However, Schein also suggests that the ODer plays the largest part in this diagnostic activity; McLean et al (1982) support this assessment.

Other writings on 'change-agency' (eg Feeney and Sladek, 1977) betray an imbalance of power, in favour of the consultant. Tichy studied various types of change agents, and classified them according to their "leverage point" and their "relationship with the system undergoing change" (Tichy and Hornstein, 1974). Tichy studied US operations researchers, whom he classified in terms of their leverage point (*from inside the client organisation, at the top*) and their relationship of *advice* (rather than force, or collaboration) with the client.

The idea of collaborative working can also be found in the activity known as "counselling" (Hansen et al., 1982, also Blake and Mouton's 'acceptance' approach, 1976), where both consultants and clients view the client's emotional and mental processes and social behaviour as being at least part of the problem.

Kubr's description of the role of management consultant is interesting. He distinguishes between a resource consultant, who provides a service, and a process consultant, who is relatively collaborative. However, both roles are claimed to adopt an "impartial viewpoint" (Kubr, 1976). This phrase has often been used by OR and management consultants. Taken literally, this implies an extreme approach whereby the consultant is not concerned with the *particular* viewpoint of the clients; the clients' beliefs and values are not critical to the consultant's analysis of the problem. In other words, the consultant regards the problem as external to the client, and sees no need for collaboration.

6.4 Consultants' Contribution to Problem Solving

The most straightforward (to comprehend) contribution that a problem-solving consultant can make to the clients' processes of handling the kinds of problems that are encountered in OR practice, is to impart understanding about the content of the problem at hand, which is usually concerned with management of a complex object system. However, there are a variety of ways in which understanding can be imparted to the clients. For instance, one practitioner remarked that

> "sometimes the outcome of a project isn't really an answer. It may be information, a system you've developed, or an evaluation of some possible method".

Another said that his aim is to

> "provide some sort of insight into the problem that's being dealt with - *one way or another*" (emphasis added).

6.4.1 Understanding through information

Understanding about the complex object system may simply constitute *information* about the nature of the system. This

information may provide a *description* of the system, or perhaps an *explanation* of its workings. It may provide *predictions* of how the system might perform under certain circumstances, or advice concerning how the system could be *controlled* by taking certain actions. In such cases, understanding of the system is likely to include *value statements* about which actions are preferable, as well as information about the system itself.

One approach used by the OR practitioners in this study is that traditionally associated with 'backroom' research. This involves communicating understanding (*"results"*) in a direct manner through a written report, and possibly an oral presentation:

> "If you've put a report together properly, providing them with all the necessary information in the best possible form, whatever they decide at the end, that's up to them".

OR practitioners in this study were concerned with imparting various types of information and understanding. The quotation above is an example of a situation where description (or perhaps explanation) was the sole aim. Another practitioner described attempts to provide explanation in terms of "working back from symptoms to causes". In these examples, practitioners are helping clients to develop *theories* about their situations.

Two ORers in this study were adamant that this kind of information, alone, is insufficient. One said "we rarely write reports just to inform people"; the other said "I think we always end up with recommendations. I think that's what should be done. .. the bottom line". This approach appears to be consistent with that of Ackoff and Sasieni (1968), who regard prescription as ORers' ultimate aim. The provision of information to decision makers can become an end in itself, and it is quite common to hear workers from statistics and business information units talking about 'quality information'

which, while supposedly producing 'quality decisions', is devoid of any reference to the decision process itself.

However, the ORers in this study were aware that, because of the decision/action orientation of their clients (and problems), *information* often seems to have implications for *action*. Edwards and Roxburgh (1977) state that "the value of information is a function of its effect upon behaviour". Similarly, one of these ORers commented

> "you tend to say 'well, if these numbers mean what we think they mean, then we ought to be doing *this*"

Another said that

> "sometimes you do a project, .. and you come back with the answer, and they say 'Oh, well that means I ought to do such-and-such', and that's something that you hadn't even though of".

In other words, even if ORers *do* recommend certain courses of action, clients' fresh insight may lead them to *different* conclusions. However, these OR practitioners are concerned, not just with the development of theories, but also with the development of *proposals* for action

At the beginning of this section, I quoted an ORer saying that a project's outcome may be the provision of a "system" - i.e. a computer system. All of the ORers in this study referred to the *use* of computer systems, but most regard them as *resources*. Where they are given to clients at the end of a project, this is normally so that clients can use to them to access *information* (of various kinds) on a regular basis. However, one practitioner said:

> "What we don't do is a post-implementation review. .. We just *assume* they've used it".

On another occasion when a computer system had been developed, he commented

> "I think we could have got involved in helping them to analyse how they *use* the system".

It appears that there are some situations in OR where the provision of *information technology* is almost an end in itself.

6.4.2 Enhancing intellectual processes

All these slightly different approaches to information and understanding relate to the relatively technical matters which are perceived to be at the core of problems. They are aimed at reducing UE (uncertainty pertaining to the decision-making environment). We must now consider how the provision of information actually aids client *processes*, and also how ORers contribute in other ways to these processes.

An individual manager's experienced trauma can be reduced by information, if it was caused largely by ignorance of the object system, or UE. There are, however, other ways in which problem-helping consultants aim to effect improvement in clients' mental coping and decision-making processes. Most directly, a consultant may provide a "counselling" type of support to the client. Here the consultant aims to interact with the client's puzzled processes, and to 'prod' them into receiving, comprehending, classifying and evaluating data that is relevant to the decision processes. Whilst the OR profession is not traditionally noted for this kind of support, the ORers in this study were very aware that this is part of the contribution that they make to clients' decision processes. On practitioner commented that

> "sometimes you just sit down and have a chat, and at the end you don't really do anything, you just chat generally about the problem, and help them to see it in a different light".

Another recounted similar experiences:

> "just talking to them may make them feel happier. .. just take the problem off them, take responsibility for it, talk to them about it, boil the problem down - break bits off - you don't really *do* anything. ..

> hold their problem while it's hot - relieve them of it, and then, between you, come to realise that it's not so bad".

In these situations, no *new* information is being provided by the operational researchers. Instead, they are enhancing clients' intellectual capabilities to formulate theories and proposals from information that is already available to them.

In section 6.1, I discussed the ways in which clients' problem-handling efforts may be related to their ongoing management processes. Although client managers are continually involved in 'issue' handling, they may also benefit from extended periods of reflection. One OR practitioner described his contribution in these terms:

> "When you've got somebody in a line position, being bombarded with information .., they haven't got the chance to sit back for the afternoon, put their feet up on the desk, and just generally think 'what are my objectives', .. do things like quick SWOT analysis, .. just sit down and play all those games".

Problem-helping consultants, such as ORers, can aid their clients by 'taking time out' when their clients are unable to do so. This is a way of enhancing their issue-handling capabilities.

The aim of enhancing clients' mental processes, so that they can formulate theories and proposals for action, is more commonly associated with other branches of consultancy. Cropper (1984, 1987) describes two common aims of "decision managers" as "to aid articulation, definition and clarification of the issues", and to generate understanding of the structure of decision processes. The latter type of help would equip the client to act more effectively in both what Radford (1987) calls the "strategic" and "tactical" phases of decision making. Churchill (1987) describes his aims in terms of "strengthening analytical skills" and "helping participants explore their own thoughts, values and feelings". Schein (1969) writes of "process consultation" as "a set of activities .. which help the client to perceive, understand

and act", whilst Bennis (1969) describes OD as being "intended to change the beliefs, attitudes, values and structure of organisations so that they can better adapt". All these approaches suggest that providing information about an object system is, at the most, only part of the overall process of decision aiding.

ORers in this study were aware that one way of reducing the trauma that surrounds a difficult decision situation is to assure the decision maker that 'someone else is dealing with it'. Many OR consultants, including some that were interviewed at length in this research, extol the virtues of their consulting approach by emphasising that they *relieve* clients of the *burden of their problems by taking responsibility* for the problems *"from formulation to completion"*. This is the role that Bryant (1989) and, in daring moments, other OR consultants call "Super-hero". Paradoxically, this role is one of *service* to the client whereas, following Eden (1987), we can see that helping clients to *finish* with problems is associated with collaboration with the client so that his/her mental and emotional state can be properly discerned.

At this point, it is important to note that an ORer's contribution to the decision process, and in particular the information which he may proffer, may *not* help to relieve trauma, and may even heighten anxiety. ORers in this study made it clear that there are occasions when they 'impart understanding' about the object system which conflicts with clients' present beliefs. Their response in this situation is to look for "a compromise between what the client wants and what's best".

6.4.3 Enhancing social processes

The above discussion is concerned with the ways in which OR practitioners aid clients' processes of theory and proposal

formulation. Throughout, the "client" is the problem owner - an individual, or a small cohesive group. However, problems are *sometimes* defined to encompass the broader, social processes of decision making. Even when they are not, ORers are interested in the social relations within which their project 'results' are received.

One OR worker, who works in local government, spoke about the process which follows the production of a report by the OR group: a report may be read and criticised by a number of different people or groups, some (though not all) of whom have authority to make decisions. Consequently, reports are often written in a way which expresses *more than one point of view.*

Another ORer described how his support to his problem-owning clients does not cease after proposals have been formulated:

> "I'll be involved in helping the client to take those ideas wherever is necessary to get them implemented";
>
> "the debate is probably taking place between your client, the other members of his group, the people above him, the people below him, and you're kind of 'in there' and talking to all these people";
>
> "the contribution we can make to debate can be useful".

This contribution is described as attempting to "focus debate on the key issue". However, the ORers' view of what is "the key issue" is heavily influenced by his work in support of one particular manager. Nevertheless, such conscious attention to social processes would seem to increase ORers' opportunities to contribute to the reduction of UR (through coordination and discussion) and UV (through policy guidance and argument).

Other types of problem-helping consultants are more regularly concerned with enhancing *social* processes, as the 'resolution' of these processes is recognised to be an integral part of problem solving. For instance, Checkland aims to "orchestrate a debate which is meaningful for people" (Checkland, 1985). In other words, enhancing social processes is central to his

methodology; clients make progress in the formulation of theories and proposals *by participating in, and interpreting, debate*. Cropper describes two consulting roles of "facilitator", whereby the consultant aims to generate dialogue and (through this) understanding, and "conceptualiser", whereby the consultant is concerned to improve "structures for thinking about choice" (Cropper, 1984).

In general, we can say that OR aims to be **instrumental** in the processes of decision-making. One specific way in which this can be done is by defining an "OR problem" (Lagergren, 1981), which is a subset of the whole problem, is relevant here. ORers may 'solve' a sub-problem, in the sense of proffering fresh understanding about certain parts of the whole issue. Eilon (1982) writes of "throwing light by OR methods on at least some aspects of the problem". This is certainly the approach adopted where ORers are involved with working parties. Here, the ORer is *part of a multidisciplinary team*, and is usually expected to be concerned with those parts of the problem that are "supposed to be amenable to an OR approach" (Lagergren, 1981), which, in this context, means numerical analysis.

6.4.4 Dynamics of problem helping

The preceding discussion assumes that a problem-helping consultant is continuously contributing to client processes in some way or other. However, the mental and social processes which comprise organisational decision-making have some regularity such that proficiency in making decisions at one time, about one issue, has a value which extends far beyond a single episode in organisational life. If decision-making abilities are improved on one occasion, then subsequent decisions may also become easier. It may be possible to discern a stream of decision events in a client's life which

seem to have the same or very similar features, such that we may talk of "repeated" or "routine" decision processes.

Quite a common aim of ORers and other consultants is to aid clients in such a way that they are better equipped to deal with future potential problems. It has been said that, in this way, problem-solving consultants are in the business of doing themselves out of business. One ORer in this study remarked "I'd like to think that we help people to help themselves [but] I'm not sure how successful we are at that". This approach may be described as *development* (of problem-handling capabilities), as opposed to merely *relief* from immediate trauma. In this sense, we can see that the problems which concern ORers are partly concerned with engineering less trauma-prone environments, rather than just with traumatic experiences themselves. Lagergren (1981) writes of ORers who "try to create a problem-solving atmosphere rather than to solve problems".

Bevan (1976) is also concerned with a 'developmental' approach, when he says:

> "The sponsor has his own mythology which .. provides him with a basis for action which mostly works to his satisfaction .. the sponsor really wants his mythology improved so that he can operate more powerful myths".

An OR consultant may find that there is not a simple and immediate correspondence between his activities which help to *develop* myths, and his clients' activities which constitute the *use* of these myths:

> "sometimes you will say something to them, and they will ignore you, and a year later they spout back to you everything you said to them a year ago. You don't know if what you said really influenced them".

There are other types of consultants who also aim to transfer problem-handling capabilities to their clients. Kubr writes (1976, of management consultancy) "the consultant's function is that of a physiotherapist, not that of a crutch". Schein

(1969) refers to the role of "sociotherapist", and views "the passing on to the client of diagnostic skills" as part of the process consultation approach to organisation development. Whilst consultants may aim to enhance clients' capabilities by ad hoc means, an obvious approach is to aim to enhance the clients' capabilities by *passing on* skills that the consultant used to develop understanding of the object system. This approach is common to Checkland (soft systems methodology), Friend and Hickling (strategic choice approach), and Mayon-White (systems intervention strategy), whose ways of working lend themselves to "use within the organisation without the need for the consultant as an 'expert'" (Mayon-White, 1987).

It is, of course, debatable how true consultants remain to these ideals which, in the long run, leave clients self-sufficient. The OR Society's Commission on OR practice remarked on the "migration" and long-term "dissemination" of OR methods, and described these phenomena as an "extension" of OR (ORS, 1986). It is argued that OR (as a consultancy activity) remains alive by developing new approaches to new problems. This is consistent with the pragmatic approach that the Commission noted, whereby "practitioners use the methodology and the tools or methods, which meet the needs of the case as quickly as possible". It does, however, make it very difficult to try to define or describe OR in terms of its approach or techniques.

A corollary of the points above, about long-term decision support, is that consultants may not spend all of their time addressing decision problems that involve new, one-off, difficulties and processes. Indeed, the testimony of this research is that OR consultants' contribution to enhancing decision processes may be made in an irregular sequence of bursts of such activity, interspersed with lulls which may be described as "maintenance work". One practitioner in this study said that *most* of his work is of this kind. There is not, in OR work, a simple one-to-one relationship between the amount of consulting effort (in terms of 'man-hours') and the

amount of impact that the work is having on decision processes, or its relevance to current problems.

OR practitioners in this study spend much of their time doing maintenance work, which means that they are updating, refining or otherwise attending to a contribution that was made to clients' decision processes at some earlier date. The overall aim of such activity is (i) ensure that (routine) decision processes do not degenerate due to lack of attention, and (ii) to maintain good working relationships with clients. ORers also do a lot of "ad hoc" work, "straightforward technical projects" and other "small bits of work", which have broadly the same purposes.

6.5 Solution Leverage and Focus

In most cases, *clients* consider their problems to be rooted in an object system, rather than within their mental or social processes. If a consultant attempts to enhance these processes, rather than to provide information or recommendations, he/she adopts (what I shall call) a *solution leverage* which is distinct from the location of the clients' felt needs. This approach to 'solving' the problem is *indirect*.

This is sometimes, ambiguously, referred to as "process consulting". If, however, clients actually *experience* problem that are rooted within their own processes, then a consultant offering to enhance these processes is approaching problem solution *directly*. It would be misleading to describe this approach as 'process' consulting, since the consultant is not trying to enhance the clients' *processes* of problem handling.

In section 6.4, I have described various popular approaches whereby a consultant attempts to enhance clients' problem-handling capabilities. I have described this as the consultant's *solution leverage*. Another subtle distinction

concerns the *focus* of ORers' attention. It is often assumed that problem-solving consultants such as operational researchers actually *address*, the same 'thing' that is the *root of clients' problems*. In this section, I shall discuss whether or not this is the case.

In a very influential paper, Ackoff (1979b) wrote that

> "the best way to treat a headache may not be to treat the head. In fact, the best treatment may not involve treating the body at all, but changing its environment"

This principle is readily accepted in the case of headaches, but is less well developed in the case of problem solving.

The ORers in this study devote much of their attention to *understanding a complex object system*. This is consistent with the 'normative" OR that is portrayed in literature such as Tomlinson, 1974, and Lagergren, 1981), and is usually taken for granted in describing OR methodology. In this, *their approach parallels that of their clients*, who are also trying to understand this system for which they have management responsibility. This approach is, therefore consistent with their ideal of *partnership*. Paradoxically, their "client-centred" approach involves focussing attention away from the client, and onto the object system which is the client's concern. ORers are engaging in the substance of the problem in the same way as clients and other organisational actors do.

However, there are occasions when ORers do not actually engage with the object system in this way, but still *intend* to address the same issue as their clients: Sometimes, an ORers' work consists of "formulating a model", and then "analysing data to see if the model is valid". Here, the "data" is taken as a proxy for the object system itself; the ORer *assumes* that the data provides an adequately accurate description of the system which is at the core of a client's problem.

The indirect solution leverage which forms part of ORers' approach consists in ORers' hope that clients will benefit (in terms of learning improved problem-handling skills) from the experience of working on problems in collaboration with a consultant. As one ORer in this study commented, this approach is similar to the traditional craft *apprenticeship* model, whereby an apprentice learns a trade from the experience of working alongside a master craftsman. Two comments need to be made here. Firstly, apprenticeship is not the sort of consulting 'service' that would appeal to clients. It suggests an 'I-can-do-your-job-better-than-you-can' attitude which ORers reject totally. Secondly, apprentices do not learn solely through experience, but also receive on-the-job training. This is an essential part of the process, and requires clients and consultants to be conscious of a teacher-pupil relationship which may be inconsistent with prevailing authority relationship between OR workers and client managers.

In his book "Decision and Control", Stafford Beer described OR as "an extra, scientific, lobe of its [management's] brain" (Beer, 1966). The intention of OR, he argued, is to "augment" management decision-making processes. This offers a more accurate, and attractive, description of the role of OR consultants: a role in which they engage in the substance of clients' problems in order to impart understanding to ease the problem at hand, and in which they *complement* clients' problem-handling processes, in the hope that their complementary contribution will 'rub off' and be incorporated into clients' normal ways of working.

Eilon's "seven faces of research" (1975) include many different approaches to 'problem-helping', which can be distinguished in terms of their *solution focus* (i.e. what the researcher addresses). Eilon's 'chronicler', 'puzzler' and 'empiricist' are all engaged in the substance of the problem, whereas his 'iconoclast' and 'classifier' direct their attention towards clients' working processes. His 'change-

agents' seem to address both. Only his 'dialectician' focusses his attention on clients' social processes.

As Checkland (1981) describes (what he regards as) traditional systems analysis / systems engineering approaches, the consultant undertakes to study the object system, as a service to the client. In Checkland's soft systems methodology, clients' social processes of negotiating problem definition and progress are key features. Here, the consultant attends to both the mental processes by which clients make sense of their world, and the social processes by which they negotiate progress. However, the consultant is also involved as a member of the client 'team', attempting to understand 'the' complex system in a way that makes sense to the clients.

OD consultants focus *directly* on the social processes which are the root of their clients' problems, "diagnosing the organisation system (or problem)" (Tranfield and Smith, 1983). McLean et al (1982) criticise the OD approach on the basis that OD consultants' ideals, whereby they "encourage people to pay attention to the patterns of their own behaviour", are not matched by the reality in which consultants make diagnoses themselves.

Tichy's research explicitly addressed the relationship between consultants' "diagnostic categories" (broadly, what assessments they make of clients' problems and the systems in which they are imbedded), and "what they work on directly" (Tichy and Hornstein, 1974). Here, US operations researchers are described in the following way:

> "They *focus* on the formal structure, work process, resource limitations of the system and its performance. Most reported that change is brought about by *working directly* on the Formal Structure and the Work Process" (emphases added).

Tichy (1975) draws the apparently trite conclusion that

> "we see a relationship between what the change agents look for and what they do".

In other words, operations researchers, and the other consultants studied, all *address directly* those things which seem, to them, to be weak.

This seems to describe *some* of the work done by the UK ORers in the present study. However, I have noted that some of their work is *data based,* to the extent that they may never actually study the object system. Moreover, we have seen that UK ORers are also aim to contribute to clients' processes by enhancing their problem-handling capabilities. I found little evidence that ORers *directly worked on* and studied clients' problem-handling abilities. Instead, ORers aim to complement their clients' existing abilities with their own abilities to study and comprehend complex object systems. The nature of ORers' special skills and expertise are discussed in the next chapter.

6.6 Summary

Problem handling may blend almost seamlessly into normal organisational processes of *issue-handling*. However, when a situation is *identified* as a problem, its resolution entails a problem owner's *relief* from decision-related trauma, and his increased *understanding*, both of his complex environment, and of the extent of his *discretion*.

OR practitioners aspire to aid problem handling by *collaborating* with problem owners. Less intimate relationships are sought with other stakeholders.

ORers contribute principally by *imparting insight* into the object system, through *information* about the nature of the system, and its implications for problem owners' discretion. They generate understanding principally by *studying* the object system, or by studying *data* which is assumed to a valid proxy for the object system itself. They are relatively unconcerned

with the *social* and political elements of clients' environments, except where they *impinge* on the object system.

ORers also aim to *enhance* clients' capability to formulate *theories and proposals*, and to *engineer less trauma-prone environments*. This kind of contribution is made through a form of *'apprenticeship'*, whereby clients learn improved problem-handling *skills*, and may benefit from appropriate information technology.

OR practitioners are not *continually* involved with addressing and solving 'new' problems, as defined in chapter 5. Their work also includes attention to the information, and IT *environment* of their clients, in order to develop problem-handling capabilities.

Chapter 7

O.R. EXPERTISE AND TECHNOLOGY

Some consultants shun the notion of expertise, as it may suggest that the consultant is claiming omniscience, or at least claiming to know more than the client. I am using the term here to describe whatever it is that the consultant brings into his consulting relationship with the client which is unique, or at least justifies his presence in the midst of other peoples' problems. In almost all cases, this will involve some area of knowledge or skill or resource which is superior to whatever the client could call upon in his workaday situation. Occasionally, consultants are employed merely as an "extra hand" - as another member of a team, with nothing special to offer, but on a convenient short-term contract. Such work seems to be "not desperately popular" with OR practitioners.

Expertise may come in a number of different forms:

It may be 'expert' knowledge which is directly related to the source of the clients' trauma i.e. the *substance* of the problem; alternatively, consultants may use knowledge of different kinds.

It may be 'expert' skills which are relevant to the problem area because they can be used to generate, facilitate or organise knowledge. If a consultant conceives of problem-handling processes as being essentially *social* processes, then he may offer 'expertise' in terms of these processes. Alternatively, skills may comprise an 'expert' *intellectual* process.

It may be a resource or technology which the client does not possess. Sometimes skills become crystallised as techniques or technologies.

I shall begin by considering ORers' use of substantive knowledge.

7.1 Expert Knowledge

When the ORers in this study were asked to define OR, they emphasised their 'approach' or 'method'. None referred to substantive knowledge that might be relevant to clients' problems. Indeed, interviewees made only incidental reference to such knowledge; it was not something that sprang to mind when asked about their expertise. Moreover, as they described the process of carrying out OR projects, they hardly referred to reservoirs of knowledge and experience from which they could draw.

However, most of the OR practitioners in this study made explicit reference to (what they humbly term) "background knowledge". This phrase suggests that the amount of knowledge required by ORers is less than that possessed by their clients, but sufficient for them to be able to understand what clients are talking about; ORers spoke of a *broad* (rather than deep) knowledge of their organisation (".. we see more of the organisation"). They also require knowledge of the function(s) or department(s) which owns the problem at hand.

The phrase "background knowledge" also suggests that this knowledge is not ORers' main form of expertise - or, at least, that they don't *think* it is. Here, they differ from other types of consultants who offer substantive knowledge as their main form of expertise. Most notably, management consultants offer "considerable knowledge of varying management situations and problems", based on "experience" (Kubr, 1976). Nevertheless, one interviewee said that sometimes his

contribution is as "just an experienced local government worker. Experience of working in this environment *is* important".

Ackoff (1979b) makes the point that study of a situation *cannot* proceed purely on the promise of special skills: "imagine surgeons who have been trained in the use of surgical instruments but know nothing about anatomy and physiology"; Surgeons must also have 'background knowledge'. It should be noted, however, that ORers do not *take over* the processes of diagnosis and healing in the same way that surgeons do, so they have less need for substantive knowledge.

It is now popularly considered that substantive expertise is more easy to "sell" to clients than problem-helping skills. This point is well made by Powell (1989) who regards attempts to offer "process" assistance (i.e. skills for problem-handling) as "incompatible with commercial consulting". [Holland's research reveals a trend amongst ORers towards describing their approach in terms of "expertise" rather than "problem solving" (Holland, 1988). Unlike Holland, I do not accept this as a change in OR consultants' *approach*, rather as a trend towards describing OR in a *language* which portrays a more *business-wise* and *less academic* profession.] Powell's criticisms are aimed at decision-aiding approaches such as those of Philips (1987) and Eden (1989b). However, the recent popularity of "soft" OR approaches within the practicing OR community suggests that this may not be entirely true. The attraction of consulting approaches based upon expert skills, rather than expert knowledge, lies in their claim to be '*client-centred*'.

There is a truism that seems to evade many consultants and authors on consultancy approaches which offer analytical skills which can be applied to problematic situations: if consultants *study* an object system effectively (such that they are able to impart understanding to the clients), they will develop *substantive knowledge* concerning the systems managed

by their clients. ORers' underemphasis on knowledge and experience, and their development of knowledge through study, are consistent with the place of OR in career development, in the sense that many OR practitioners are young graduates, and that OR is often regarded as a route into a management career, rather than the other way around.

7.2 Expert Skills and Technology

OR practitioners' main areas of 'expertise' are expert *skills, techniques and technologies* beyond that which is possessed by their clients. It is difficult to draw lines between things that can be called 'skills' or 'techniques' or 'technologies'. The roots of the word "technology" (from Greek *tekhne*) suggests associations with art and craft. In modern parlance, however, the term connotes objects, usually with moving parts, often connected to a source of power, and often controlled with the aid of micro-electronics (as in 'hi-technology').

This breadth of meaning is apparent in published research into the impact of technology within organisations. As Ezzamel (1989) notes,

> "approaches adopted by researchers to define technology range from those emphasising its physical dimension, .. to those that encompass all work performed in organisations".

This range of meaning is also apparent in OR literature: Scholtz (1984) defines technology as "the actual solving of a real problem by means of a specific set of instruments", whilst Yewlett (1984) defines technology as the "use of different kinds of organised knowledge" for "practical tasks". In both these examples, "technology" is contrasted with 'science' - *development* of knowledge - and is not describing the characteristic resources of OR workers.

In describing the special contribution that (soft) ORers make to clients' problem-handling processes, Cropper (1987) uses

the term technology to mean *"theoretical and modelling structures"*. This is approximately my meaning here. Boothroyd (1988) has used a similar notion: that of the "armour" with which ORers are 'girded' as they go into 'battle'. During interviews with OR practitioners, I investigated ORers' technology within the following five categories:

(i) computer hardware
(ii) computer software and programming facilities
(iii) techniques (traditionally associated with OR, or borrowed from other disciplines)
(iv) other aids (petty hardware, diagrams etc.)
(v) skills (including abstract technology, conceptual frameworks, procedures etc.)

These categories are only loosely defined, but seemed to capture a wide variety of resources used by OR practitioners. At the 'soft' end of the spectrum (intangible structures and mechanisms), technology seems to merge seamlessly into the personality and skills of the ORer him/herself. I make no apology for this somewhat blurred boundary.

7.2.1 Techniques maketh OR ?

For most people outside the OR profession (but who are familiar with the name "OR"), the use of a particular set of analytical techniques is a characteristic (or even definitive) feature of OR work. Indeed, "OR" may well be equated with a set of techniques similar to those that are described in a series of university textbooks that have been published since the 1960s. These books still grace the shelves of many libraries. The list below gives a rough guide to the techniques that are described (or prescribed) in these textbooks:

Mathematical programming	30 %
	(approximate proportion of the volume of popular textbooks)
Stock control	10 %
Critical path analysis	10 %
Queueing theory	10 %
Simulation	10 %
Statistics and probability	5 %
Replacement	5 %
Game theory	<5 %
Forecasting	<5 %
Others	10 %

This list is based on thirteen popular British and American OR textbooks. The balance between the various techniques is roughly the same for British and American books. The main differences appear to be a greater emphasis on mathematical programming in the US, and a greater emphasis on replacement and forecasting techniques in the UK. In total, all the techniques comprise at least 90 % of the volume of the textbooks (Woolley and Pidd, 1981). As Haley (1984) pointed out, in an address from which this section takes its title, the textbook accounts of techniques were principally attempts to structure and generalise what was being done by OR workers, and the tools they were using. In this section, I shall examine results from recent studies of OR practice, including my own research, and consider:

Can any generalisations be made about contemporary OR techniques ?

If so, how do these results compare with those reflected in the traditional OR textbooks ?

7.3 Techniques in Contemporary OR Practice

A number of surveys of OR practice during the 1980s have inquired about the techniques used by OR practitioners (or groups). Carter (1987) asked over a thousand members of the UK OR Society to measure their use of 14 OR techniques using a scale from 1 (never used) to 5 (frequently used). The average scores are shown below:

Statistical techniques	3.2
Simulation	2.7
Forecasting	2.6
Financial modelling	2.5
Heuristics	2.2
Surveys	2.2
Critical Path analysis	1.9
Corporate modelling	1.9
Stock Control	1.9
Mathematical programming	1.9
Decision analysis	1.8
Queueing theory	1.5
Quality control	1.4
Others	2.1

"Other" techniques, in total, were only used "frequently" (score 4 or 5) by 21 % of practitioners. This indicates that the 14 techniques offered were felt to cover OR practitioners' techniques fairly comprehensively.

Carter's survey suggests that much greater use is made of statistics-based techniques than is implied by the textbook coverage. It is interesting to note that *none* of the techniques in the top half of the table above are based on mathematical methods of *optimisation* (i.e. finding 'the best' way to operate an object system) which is portrayed in OR textbooks as an *axiom* in OR methodology. Another interesting feature is the appearance of "financial modelling" and

"heuristics" as legitimate OR techniques; both are 'umbrellas' which cover a variety of modelling approaches.

In Jane Holland's research at Hatfield Polytechnic, OR groups were asked to specify the technique (from a given list) that was used, for each project over a six-month period. The first part of the research (based on six groups) yielded the following results (Holland, 1988):

Computing	22 %
Statistics	11 %
Information systems	9 %
Special modelling	8 %
Data modelling	6 %
Simulation	6 %
Systems analysis	5 %
Forecasting	5 %
Investment appraisal	4 %
Stock control	3 %
Scheduling	2 %
Mathematics	2 %
Financial planning	2 %
Others, from given list	8 %
Others, not from the list	5 %

Note that the percentages add to 100 % - it appears that only one technique could be specified for each project.

It is interesting to note that when ORers are offered "computing" and "information systems" as techniques to describe projects, these amount to 31 % of the total. It is not possible to tell how many of the other 69 % of projects utilised computing facilities as well as the stated technique.

As with Carter's research, the inclusion of "special modelling", "data modelling", "financial planning", "investment appraisal" and "heuristics" (totalling 22 %), suggest that the traditional textbook classification of

techniques may be inadequate for describing the techniques used by ORers. Of the popular textbook techniques, statistics (11 %), simulation (5 %) and forecasting (5 %) are all basically non-optimisation tools. The remainder of the textbook techniques total less than 10 % of the projects in this survey.

Beasley and Whitchurch's (1984) survey of young OR workers yielded the following results, which show the percentages of young ORers who "frequently" used each technique:

Computing	97 %
Simulation	32 %
Forecasting	32 %
Regression	32 %
Statistics	32 %
Heuristics	15 %
Linear Programming	<5 %
Queueing	<5 %

In Mingers' (1991) survey of OR groups, he asked which 'techniques' (and other things) they would like to see included on an MSc course in operational research. Their favourite techniques are listed below:

Simulation
Spreadsheets
Basic probability
Microcomputer basics
Probability distributions
Basic systems concepts
Computer programming
Descriptive statistics
Significance tests

Clearly, this list includes a range of techniques and technology, including "computer programming" and also "basic systems concepts". However, it is noticeable that simulation

is the only 'traditional' OR technique on the list of "favourites". (Other techniques which did not quite qualify for the above table included "linear programming formulation" - "LP algorithms" was way down the list - and also "multiple regression" and "heuristics".)

Bennett and MacFarlane's study (1992) found the most commonly used OR techniques to be as follows:

Statistics
Simulation
Forecasting
Operations managements (inc. Quality)

They also discovered extensive use of spreadsheets.

The findings of these five surveys can be summarised as shown below, along a spectrum from 'hard' (technology) to 'soft' (skills, abstract technology):

Computer applications - *used frequently:*

inc. Microcomputing
Programming
also, Spreadsheets, Information systems etc.

Traditional OR techniques - *used occasionally:*

inc. Linear programming
Stock control
Critical path analysis
Simulation - used frequently (see below)

Heuristic / Descriptive modelling - *used quite frequently:*

inc. Heuristics
Data modelling
Financial modelling

Applied statistics and probability - *used frequently:*

inc. Forecasting
Regression
Statistical inference and tests
Probability distributions
and simulation (see above)

Basic modelling languages and concepts:

inc. Mathematics
Basic systems concepts

(*Probably used frequently, but not often described as 'techniques'.*)

7.4 Techniques in This Study

This section presents the findings of my fieldwork among OR workers, jointly describing their use of *techniques, computing hardware and software applications*. This is because the software applications are bound up with the techniques, and have not been analysed separately in any of the studies reported above.

The following table shows the *techniques* that were used by the OR practitioners in this research. The figures represent my *subjective* attempt to measure and aggregate these ORers' descriptions of how often they use the techniques. The

percentages indicate the approximate *frequency* with which a particular technique is chosen, *out of all the occasions when one of these techniques is chosen* (possibly more than one choice per project).

Statistics	25 %
Simulation	15 - 20 %
Heuristics	10 - 15 %
Mathematical programming	10 - 15 %
Financial modelling	10 - 15 %
Data modelling	5 - 10 %
Queueing	<5 %
Expert systems	<5 %
Others	5 - 10 %

There is a noticeable similarity between these results and those cited by other researchers, particularly those of Holland. This similarity is able to serve two useful purposes:

1 It offers confirmation of the findings of Carter, Holland, Mingers, Beasley and Whitchurch, and Bennett and MacFarlane. It supports the summary, on the previous page, of the 'popularity' of the various techniques (and *categories* of techniques). It provides further evidence that the traditional OR techniques, as described by OR textbooks, are no longer the techniques which are most regularly used by contemporary practitioners of OR.

2 It offers a rare chance to check how *representative* my findings are of contemporary OR practice. Usage of techniques is the most easily distinguished and easily studied aspect of OR practice. The availability of the results of other recent studies offers a chance to make comparisons. The similarity between my results and those of other, larger, studies is encouraging, and adds credibility to my findings overall.

In employing the techniques described above, extensive use is made of computing facilities. In some cases, practitioners design and write their own software. In other cases, they use commercially available software. The most commonly used programming languages (by practitioners in this survey) were APL and Fortran, with occasional use of PL1. Mingers (1991) found Fortran to be the most popular language, followed by Pascal, C, APL and Basic. Bennett and MacFarlane (1992) found Fortran, Basic and Pascal to be most common.

7.4.1 Computer software

The use of commercial software can be summarised as follows (again, on a subjective basis, showing the *relative frequency* with which these technologies are chosen):

Spreadsheets (various packages, eg Lotus)	35 - 45 %
Databases (various)	20 %
Statistical programming systems and packages (eg SPSS, SAS)	10 %
Word processing systems (various)	10 %
Freelance (presentation software)	<5 %
Simulation packages (eg Hocus)	<5 %
Expert systems shells	<5 %
Others	10 %

NB - This includes the use of integrated business software packages which, in the above table, has been distributed amongst the various application components.

These findings are similar to those of Bennett and MacFarlane (1992), who found spreadsheets to be the most commonly used computer software, followed by statistics packages, simulation packages and databases.

The software results do not fit precisely with those for "techniques". Three likely reasons for this are:

(i) Extensive use is made of spreadsheets and databases. One practitioner commented, *"almost any model we use will be on a spreadsheet"*. However, some practitioners do not regard these as 'legitimate' OR 'techniques';

I commented earlier on the inclusion of "financial modelling" and "data modelling" as OR techniques. The distinction between software which embodies a traditionally recognised OR technique, and software which aids a consultant in some other way, is becoming increasingly unclear. (The inclusion of word processing systems is an example.)

By inspection of the above table, it might appear that although OR practitioners make extensive use of computers in their modelling, only a small fraction (possibly less than 20 %) of this modelling can be associated with the the techniques described in the textbooks. However, the use of software applications such as spreadsheets and databases for OR modelling suggests that they may properly regarded as additions to a repertoire of *modelling languages* which includes mathematics and computer programming.

(ii) Heuristic models are (almost by definition) written by practitioners themselves;

(iii) Although some linear programming and simulation models are written by practitioners themselves, it seems that either

(a) actual use of simulation and LP *packages* is, for some reason, *underestimated* in the above table, or

(b) actual use of simulation and LP *techniques* is *overestimated* in the previous table. Holland's results, in which simulation and LP techniques were the main techniques in only 6 % of the projects, suggests that this is a possibility.

7.4.2 Expert skills and other tools

My attempt to discover what other tools and 'petty' hardware are used by OR practitioners was less than successful. With some prompting, practitioners exclaimed "Oh yes! We're very big on graphs", "no end of pareto curves" etc. Others mentioned use of maps, flowcharts and 'systems' diagrams. However, informal discussion with ORers suggests that more extensive use is made of diagrams than is reflected by the results of this formal survey. Indeed, it seems that some attempt at diagrammatic representation on paper is often a precursor, or an adjunct, to computer modelling, perhaps perhaps representing something akin to what Ackoff and Sasieni (1968) term 'conceptual models'.

Conceptual modelling is basically concerned with technology *in the abstract* i.e. structures and frameworks which are used by OR practitioners, but which are not tangible or observable in themselves. In this section, I shall consider conceptual models used by ORers, any *structured methods or procedures* that they use, and the *skills* on which they draw. Some of ORers' skills may be characteristic of their approach, whereas others may be more general, professional, skills.

A structured approach

All of the ORers in this study *defined* OR in terms of the "structured approach" that they use. The various phrases that are used include "logical", "scientific", and "analytical" approach or method. These terms were used *interchangeably* by these ORers, and some explicitly stated that the different terms mean the same thing.

OR workers regard this kind of approach is characteristic of their work, yet find it very hard to describe. Two practitioners in this study attempted to explain their approach more fully. The approach of one OR worker was described as "scientific method". He explained:

> "What I mean ... It's just words, really. .. An approach whereby you objectively try to evaluate a situation"

[note that 'objectively' means that the "solution should be a logical progression from what you've done", in this case];

> "I don't know - the ability to get something defined out of a mess .. to home in on the important aspects of it".

This ORer's approach seems to fit with the "science research" paradigm that Woolley and Pidd (1981) discovered amongst textbook accounts of problem structuring in OR. A dialectic between "hypotheses", about relationships between parameters in a model, and "data" or "facts", informs his approach to problem helping. It is important to emphasise that this does not necessarily represent a *procedure* by which OR is 'done', although the practitioner's descriptions of project work provided some evidence of this, but primarily a *theme* which runs through his work.

A second OR worker described his 'structured approach' in a way that fits with Woolley and Pidd's "definition" stream of thought. Here, problems are defined with reference to the supposed standard 'shape' of strategic decisions:

> "What are your objectives? - what are you trying to achieve?; generate options, evaluate them; recommendations".

This four-part 'process' is all that is discernible in terms of a generalisable approach.

Again, it is important to note that this does not represent a procedure. As this practitioner commented:

> "It worries me, sometimes, .. that that is all we've got, really - but it does seem to work, so I'm learning to relax on that one."

The looseness of the structure in this approach is clear from the way this OR worker described his approach as

".. using logic, or .. I don't know, just *grunt*,in some sense to mush it all together in a logical argument".

Another practitioner referred to the "science research" pattern of operating, and then explained that he would *like* to claim that as his approach, "but, in practice, you don't quite *do* that". His testimony is that ORers' structured approach cannot easily be articulated as a *step-wise* method or procedure (i.e. one that can be described in terms of 'stages'). This is supported by the fact that the other practitioners in this study were unable to describe their work in these terms, even though, (a) some conceive of their approach in terms that could easily be used to describe a step-wise procedure, and (b) all the interviews included opportunities to describe the development of an OR project over the course of time.

One practitioner described his approach as "structured and scientific; reductionist - breaking the problem down into smaller systems", but then added "I'll say 'structured' and 'scientific' because I think 'structured' can imply upwards as well as downwards". The directions that he is referring to are those in which a consultant (or problem owner) may proceed in order to *resolve* a problem. Similarly, the phrases "breaking things down" and "piecing things together" are often used within a dialectic, which suggests that the "structured approach" used by the ORers in this study can perhaps best be described as 'working with structure', in a way that does not *assume* a particular direction of resolution. 'Structure' can be applied in various ways, in the context of a problem-helping relationship, and this will be explored more fully in a later chapter.

Other expert skills

Most of the techniques that were listed earlier in this chapter are techniques of *quantitative* analysis. The structured approach described in the above section is

basically qualitative, but in order to employ these quantitative techniques, "the ability to do sums is quite important", as one practitioner put it. All of the practitioners in this study had some training in mathematics and/or statistics. This is not unusual for ORers. Consequently, the use of basic numerical skills is not emphasised; ORers tend to take it for granted that they will use this kind of skill - indeed, only two practitioners in this this study explicitly referred to numerical ability.

In addition to numeracy, one practitioner described "providing intelligent totals" as a common feature of his work. On other occasions, practitioners emphasised the importance of being able to *communicate the meaning* of numbers in a way that clients who are not mathematicians can understand. My personal experience of teaching quantitative methods to non-mathematicians persuades me that this requires a *deeper* understanding of the methods than is required simply to use the methods or to teach them to mathematicians. The ability to *teach* techniques was also mentioned by one practitioner.

As with numeracy, the more basic quality of *intelligence* is rarely emphasised. This is not necessarily a unique or special skill possessed by ORers, but it is recognised to undergird the more developed forms of expertise, such as statistics, computer programming etc. On describing his 'problem-structuring' skills, one practitioner remarked, "to what extent that is derived entirely from the intellect element, I don't know - I think it comes, to some extent, from your experience and the way you've been taught to think". He commented that his OR group recruits "scientific people". Another practitioner said that his 'scientific approach' was "partly natural, and partly conditioned by the technology". The ability to *learn* techniques, and to understand when to use them, was considered by one practitioner to be more important than actual *possessing* a large repertoire of techniques. Practitioners' *choice* of technology is addressed in chapter 9.

The ability to "ask questions" in a useful way was mentioned by only one ORer as a special skill. However, as we will see in chapter 9, ORers' skills do contribute to a particular approach to questioning. One interviewee stated that "being prepared to ask obvious questions, without being afraid of looking silly", is an essential skill for OR consultants.

All the ORers studied regarded the ability to *communicate*, both orally and in writing, as important in their work. We have seen, in chapter 4, that they may have to interact with a wide range of different people; their relationships with these people is the subject of the next chapter. Many ORers referred to "interpersonal skills" separately from "communication". This suggests that ORers need to be naturally 'personable', as well as needing to know 'how to' communicate. Interestingly, none of the consultants in this study mentioned the ability to *listen* (eg to clients) among their skills, unless directly prompted.

Some practitioners referred to other skills which may be regarded as desirable in any employee, but which may have special application in OR work. These include: 'tenacity', since operational research may sometimes be frustrating; the ability to think quickly, and to respond to situations quickly; 'maturity', both in the general sense, and also in the sense of not being impetuous, and jumping to conclusions.

7.5 Summary

OR practitioners' expertise consists of *knowledge, skills and technology*, although their knowledge is a broad background knowledge of their organisation which they have developed through their consulting experience.

ORers' main expert skill is *a structured approach*, which constitutes a *dialectic* process involving *data* and *structure*. ORers are also numerate, intelligent and communicative.

ORers are equipped with *basic modelling languages* which supplement their structured approach, and are competent in the application of *information technology*, and general *business software*. These skills and technologies may simply be combined in the 'technique' of *descriptive (heuristic) modelling*. This is very common in contemporary OR practice.

More sophisticated techniques involve the *application of basic statistics* - again, this is common - or the use of *traditional OR techniques*. Of these, only simulation is frequently used, though mathematical programming is also used quite often.

Chapter 8

RELATIONSHIPS AND PROJECTS

In chapter four, I described the context of OR work in such a way that OR appears as a more socially complex activity than the traditional consultant-client diad suggests. Through interviews with OR practitioners, I identified the roles of problem owner, sponsor, user, decision participant, stakeholder and informant within the client organisation. Some roles may be played by more than one person, whilst some individuals may play more than one role: Notably, a sponsor and problem-owner may be the same person or group; a number of people may be both stakeholders and informants; there may be a group of decision participants including problem-owner, sponsor, and perhaps some users and stakeholders.

My intention, in the first half of this chapter, is to describe OR practitioners' relationships with these various social actors. ORers' descriptions of these relationships were not particularly enlightening. This is partly because relationships with clients are often thought to be "pretty much like any other working relationship, really". It is perhaps also partly because ORers are either unable to articulate what goes on in this aspect of their work, or regard attention to such issues as unnecessarily introspective (Bryant, 1988). Whatever the reason, many of the findings discussed in this chapter may appear rather trivial. Where possible, I will try to juxtapose my findings about *the nature of ORers' relationships*, with my findings about *the nature of the problem-helping roles that they seek to play*.

In the first section, I will consider OR practitioners' relationships with problem-owners, sponsors, decision makers

(participants) and users. There are some broad similarities in ORers' approaches to these relationships, so I will refer to them jointly as 'clients'. Where possible, I will indicate distinctions between relationships with various types of client; the second short section refers to a particular aspect of ORers' relationships with senior managers, who are remote from the problem-handling process, which is categorically different from relationships with problem owners and users. The third section is concerned with relationships with informants and stakeholders who are not considered problem owners. The fourth section addresses ORers' contributions to dealing with conflict within their organisations. The final sections of the chapter are concerned with the ways in which consultant-client relationships form the basis of the problem-helping methods described in sections 6.4 and 6.5.

8.1 Relationships with Clients

The importance of 'client' relations is commonly regarded as paramount. This is clear from interviews with OR practitioners. For instance, one spoke emotively of "being there" and "having time for them". Another practitioner described the potential pitfalls in his work in terms of "client cockups" and "technical cockups": a client cockup is considered much more difficult to hide, and more likely to influence the overall effectiveness of OR work. The same conclusion has been reached by many who have conducted research into factors 'determining' success in OR:

Amspoker et al (1973) found that

> "most effective project groups directed a significantly higher number of internal communication hours toward representatives from the user corporate area than did the less effective groups".

Wedley and Ferrie (1978) discovered a high correlation between "participation" and "success". The importance of 'client relations' has subsequently found its way into OR's consulting

folklore. Mercer (1981) advised that "it is always necessary to have a good relationship with all the board members". Whilst these conclusions have encouraged ORers to view their practice as a consultancy activity, they offer no indication of the social mechanisms by which relationships with clients may be developed, acted out, and maintained.

The preceding paragraphs refer largely to ORers' relationships with problem-owners, and to a lesser extent to relationships with sponsors. In general terms, ORers in this study described their relationships with these clients as ones of "professional respect and courtesy". This is a spectrum: a one end is "professional detachment"; at the other end is "laugh and a joke". The position along this spectrum which describes ORers' relationships with clients varies, but it is considered that a "fairly good" personal relationship must undergird these professional relationships. Client relations can be described in greater detail by considering the motivations that each party has for wanting such a relationship. We have already seen (in chapter 6) that ORers regard 'collaborative work' as an *ideal* for problem-helpers. We might, therefore, expect that ORers might perceive relationships as essential foundations for "working through [problem-handling] processes with clients" (Bryant, 1988). However, the evidence of the fieldwork suggests that ORers have other priorities. I shall use Churchman and Schainblatt's (1965) model of the OR consultancy process to shape a discussion of motivations in consultant-client relations.

8.1.1 Consultant understands the client

One of the two propositions that Churchman and Schainblatt used, in their well-known paper on implementation of OR, was that "the researcher understands the manager". ORers in this study considered it important to have a relationship with their clients such that they could understand them. There are a number of facets to this:

Firstly, this means understanding their feelings towards potential 'solution' options that emerge during the course of a project.

Secondly, it means being able to "understand the politics" i.e. the political elements of the decision process; there is a need for clients and users to "tell you things".

Thirdly, and in a slightly broader sense, there is a need to understand the social context of the OR project;

> "keeping up with what's going on, changes in personnel, .. jargon etc., in the client's department.

OR consultants did not explicitly state that understanding of clients was essential in order to gain understanding of problems, although one practitioner did refer to the need for a relationship which allows the consultant to ask questions, without appearing threatening. I suspect that ORers take it for granted that the problem-owner is the first and perhaps most reliable source for problem definition. Indeed, this is why the problem owner is defined as such. Regrettably, it is not possible to demonstrate that ORers practice client-centred approaches to gaining understanding of problems, or that they do not.

The data which became available through fieldwork, which I have summarised above, seems to suggest that ORers' need to understand their clients may be relatively concerned with attempting to understand the *consulting problems which face them, as ORers*, and relatively unconcerned with attempting to understand the *problems experienced by their clients* (see section 5.4.1). In other words, a dualism between 'consulting' and 'doing the work' is being used here. In chapter 5, the problems at the core of OR work were recognised to be concerned with *decision making which has a human component*. If understanding of clients' experiences is not considered important, this would seem to represent *a significant inconsistency in OR methodology*. Certainly, what Eden (1987)

describes as 'problem finishing', which requires consultants to 'track the psychological state' of their clients, does not fit with these ORers' present approach.

Eden (1989) urges that "the socially constructed reality of each of these actors [decision participants] needs to be understood. However, we have seen, in chapters 5 and 6, that ORers' contribution to this process is concerned with the *proposals* made by an individual decision participant (the problem-owner). It would therefore be surprising if ORers (in this study) were concerned to build relationships with decision participants *other than the "problem owner"*. This appears to be the case: interviews with ORers provided no evidence of relationships with 'other' decision participants. This is consistent with their "egocentric" approach to problems. Another reason for attempting to relate to 'other' decision participants is suggested by Radford's model of complex decision processes, in which each participant considers the proposals that might be made by other participants. However, ORers in this study did not express any interest in trying to *understand* 'other' participants in order to assist the problem-owner in this way.

In terms of the Churchman and Schainblatt model, it is the "persuader" who seeks to understand clients. There are two different roles here:

> "On the one hand, a scientist might want to grasp enough of the personality of the manager to be able to overcome his resistance .. On the other hand, the scientist might realise that so-called solutions to organisational problem need to be "tailor made"."
> (Churchman and Schainblatt, 1965)

The motivations described above seem to indicate that the *first* of these roles is being played. In this sense, the approach of the ORers in this study is consistent with the approach that is encouraged in published research: Scholz (1984) notes that "currently the main effort in research is 'how to get the client to understand what we want for him'".

8.1.2 Clients understand the consultant

Perhaps surprisingly, the majority of comments that ORers in this study made concerning the importance of client relations are concerned with *clients'* needs to understand the consultant, in some sense. The most basic need that clients have is to be reminded that the OR work is going ahead as agreed: contact 'reminds them that you're doing the project'; 'clients need to know you're doing something'. Beyond this, there is a need for clients "to know what you're doing".

Several consultants referred to clients' need to know that the ORer knows what he/she is doing - "encourage the client to believe that you know what you are talking about". A relationship with a consultant replaces some of the security that is lost through the decision to allow or invite the consultant to contribute to the problem-handling process in some way. Specifically, clients need to know that the consultant understands *them* (although section 8.1.1 suggests that ORers' understanding of their clients may be motivated only by their desire to solve their own consulting problems), that he respects and will use their (i.e. the clients') knowledge and expertise, and that he is aware of his own limitations.

Clients' needs are, therefore, very much concerned with retaining control over the situation, and with ensuring that the consultant does not proceed as if he had expert knowledge of the object system which is the focus of the clients' concern.

ORers in this study did not claim that clients needed to understand the consultant's motivations, methods or philosophy. I had expected that consultants would adopt this stance, which Churchman and Schainblatt call "communicator", and which embodies, in their terms, "the modern version of the philosophy of the enlightenment". However, the approach of the ORers in this study is consistent with the findings of Huysman (1970)

and Bean et al (1975) that clients do not need an intellectual understanding of OR's methods. As Lockett and Polding (1981) suggest, the required understanding is "more in a sociological than an intellectual sense", meaning "an appreciation of the roles, objectives and constraints of the other actor" (Keys, 1991b).

ORers did, however, provide some evidence of an interest in "communication" (in the sense of 'telling'). They described relationships wherein they "can give their own opinions", and "can say unpalatable things" to clients. One practitioner said that a good client relationship was one where clients were "flexible" and "prepared to discuss things, and negotiate". This kind of need for a relationship is explained by Quade (1975):

> "personal acceptance usually comes before acceptance of ideas .. information depends on the way the analysis is presented and on the decision maker's confidence in the man and the organisation from which he comes".

Edwards and Roxburgh (1977) also note that information is valued for its *origin* as well as for its content. We have seen (chapter 6) that OR practitioners are aiming to contribute information to a decision process. This interest in client relations supports this aim. Here, consistent with the 'persuader' approach, relationship building has the ultimate aim of enlightening the client - "education presupposes selling" (Churchman and Schainblatt).

8.1.3 Enjoyment, maintenance, and development of relationships

All of the OR consultants in this study emphasised the importance of having regular contact, and with spending time with their clients during projects. This contact includes formal meetings to discuss progress on the project, and also

informal encounters. Contact should be face-to-face where possible, rather than by phone.

When in contact with their clients, ORers are aware of their clients' needs for assurance concerning the progress being made on *their* problems (see above). Consequently, they take steps to furnish clients with the information they need. This means "*showing* them you're accepting and using their knowledge", "*showing* them you're doing something, and understanding them"; "don't appear cocky - *show* you know your limitations" (emphases added). Clearly, ORers are concerned with the *image* they present to their clients, as well as with genuinely respecting clients' needs to retain control over the handling of their problems.

Informal contact is usually achieved by the ORer "dropping in" to clients' offices. Obviously, geographical proximity to clients' offices is a distinct advantage here. It is then possible to

> "be in a particular office, and wander up and say 'what's happening, man?' .. you .. can say 'on my way down from that meeting, I'll pop my head 'round so-and-so's door and see how they're getting on' .. That is valuable in itself - you maintain your contact, and he sees you as somebody who's around, and will help you if you need".

Being local is considered particularly valuable by the ORers in this study who actually *are* local to their clients, and also seems to be considered important by their clients - "the manager was particularly keen that we should be on site". Curiously, however, it is *not* considered important by those based some distance from their clients.

There is a growing awareness, among ORers, of the consulting nature of their occupation, and a corresponding opportunism which shows in their attitudes towards social contact with their clients (and potential clients). One ORer in this study, whose OR group is widely considered to be successful, explained that

> "the OR manager goes off and has lunch, quite a lot, with people for whom we might potentially be able to do some work".

The same group throws an "annual clients' party" -

> "a way of clearing out the drinks cabinet. Everyone who's been a client in the last year gets invited. By that sort of means, you end up getting into the interesting debates".

This ORer also valued sharing a canteen with clients and users, regarding this as a way of being accepted on a personal level, as well as a way of getting up to date information. Another man, an OR manager, realised during an interview that he had recently visited his clients' regular lunch canteen on three occasions, and on two occasions this contact had led to new projects - "that's not a bad rate of return", he remarked.

The value of social contact has, so far, only crept into OR literature as anecdote: Chesterton (1976), in a review of Schultz and Slevin's book (1975) on implementation or OR, suggested that

> "one would find it very hard going to actually try to read it .. One would probably gain more for implementation by spending the purchase money on buying your prospective clients drinks".

Graham, who is primarily an anthropologist rather than an operational researcher, cautioned OR consultants

> "be ready to drink lots of beer .. it is while sitting at the bar that I find the informal organisation is usually revealed" (Graham, 1984).

My account of an OR Society conference, which emphasised the social programme, appeared with an editorial note explaining that 'the official, high-on-integrity, low-on-long-sessions-in-the-bar, version will appear next month' (Jones, 1988b).

Notably, both Graham and Bryant (1988) suggest that a particular *type* of information (relating to social processes,

politics etc.) is revealed during these social interactions. Those OR practitioners who utilise extensive social contact are therefore likely to learn to construe 'problems' in a different way, in which human and social factors are prominent. This is a vicious (or benevolent) circle, of course, since their consulting approach is largely determined by their notion of problems.

This approach to socialising is not universally adopted, however. One practitioner described the official social club of his organisation as "quasi-masonic - I've never been". He was no more optimistic about the chances of furthering relationships during lunchtimes: "oh! you couldn't talk to anyone in the canteen". It would be unfair to conclude that this ORer simply had no marketing skills; clearly, it is advantageous to have facilities suitable for entertaining clients. However, on a recent visit to an OR group, I stayed from 12 noon to 3pm, and was not offered a drink during this time, let alone an opportunity to take lunch with members of the group (or indeed without them). It seems that whilst ORers all claim to value relationships with clients, not all have developed the necessary social skills.

Beyond securing reasonable personal and professional relationships, it is clear that consultants must convince potential clients of the value of their work. This may be done directly, by "going and saying 'look, we've done such-and-such in this area. Would it be useful here?'". Once clients' favour has been secured, an OR group may relax its usual project selection criteria in order to maintain involvement with *certain* clients. One ORer explained:

> "we decided that .. because this thing is such an important area, it's something that we are deliberately trying to stay in, even on the basis of doing ad hoc, fairly urgent pieces of work".

Some of the OR practitioners in this study considered it valuable to inform clients, via written publications, of the nature of their recent work. The emphasis in these

publications is on demonstrating that OR can make a useful contribution to many areas of the organisation's work (and, therefore, to a potential client's particular area of work). Again, approaches vary: some OR groups have a regular bulletin, which is distributed widely, one has a magazine that is less well used, whilst other groups use no publications at all. The effectiveness of written advertisements for OR is uncertain; ORers in this study seemed to value these far less than personal contact.

It is clear, from way that the preceding discussion has evolved, that OR consultants have paid quite a lot of attention to developing relationships with members of their organisations who are either potential clients (sponsors or problem-owners), or who may become involved in an OR project at some future date. However, ORers did not emphasise clients' needs to understand their working methods during projects, and appeared to pay little attention to the way that client relationships are actually lived out during the course of a problem-helping project. Again, OR practitioners' awareness of the 'consulting' nature of their occupation seems to be shaped by a dualism between 'consulting' and 'doing the work'.

This is a surprising approach, considering that ORers popularly regard "collaborative" work as an ideal, or even essential, way of operating. In both the "communicator" and "persuader" modes, one would expect that ORers' accounts of project work would emphasise the development of (some form of) understanding between consultant and clients, as a relationship unfolds between these various social actors. The archetypal communication approach is represented by Stillson (1963) who suggests that a contact client should join with an OR team, so that "he will receive "on-the-problem" training and be allowed to participate in the formulation and solution of the problem". The ORers in this study would reject this condescending consultant-centred approach - we have seen that they do not tend to think as "communicators", in this sense. Tomlinson (1974) speaks for "persuaders" when he describes a

successful project in which ORers worked "as part of a team that was led by a member of the functional department". Most of the ORers in this study have been involved in projects where a working party could be considered to be the problem owner. However, even in these cases, the main purpose of meetings seems to be *to discuss progress that has been made in between meetings*. Meetings to not tend to be viewed as the actual occasions when progress is made.

8.2 Senior Clients and Sponsors

OR practitioners' attitudes towards relationships with senior managers, who may sponsor OR projects, or in some other way have an influence over the OR group, are similar to those described above, in terms of courtesy and professional respect. Clearly, if a sponsor is not actively involved in a project, or not genuinely a problem owner, then it is less important for ORers to understand the sponsor's deepest feelings. "Senior clients are too busy to see you", as one practitioner put it, so the need to keep clients informed of progress on their project is also reduced.

OR practitioners in this study seem concerned about being "careful" with, and *not upsetting* senior clients, rather than with positively building relationships with them. One ORer advised "be careful with senior clients - there's not many of them about". Another practitioner said that he considered himself to be working amongst colleagues, "but I might be a bit more careful if one of them's paying the bill". Clearly, such people are valued because of their seniority, and their financial commitment. One practitioner explained that sponsors' interest and support are also valued because of their *experience* and *breadth of knowledge* within the organisation: "if he's not convinced that a project is worthwhile, then perhaps it isn't". However, as Polding and Lockett (1982) suggested, it may be "lack of top management opposition" which

is the important factor, rather than active interest and a productive working relationship.

In developing suitable relationships with senior managers, formal high profile marketing efforts, such as clients' parties, open days, are considered appropriate. These activities do not threaten managers' position of seniority, and suggest that the OR group are concerned to *serve* and *inform*, rather than to meddle in other people's business. One ORer explained that his group's marketing strategy had enabled them to secure greater support from senior managers, and to

> "move to a 'strategic' level, partly by doing work at special rates for people who are not desperately senior, but who are likely to be desperately senior in the not too desperately distant future".

8.3 Hosts, Stakeholders and Informants

OR practitioners in this study adopt categorically different approaches towards relationships with other social actors, such as those who may be affected by a project's outcome, and those who can provide data or information which is relevant to the problem at hand.

The need for relationships is still expressed, but these individuals do not have the power to determine whether or not a current or subsequent project goes ahead, so their support and well-being is not considered so important. However, people who hold data or information, which is of use to a consultant, can significantly influence the course of a project, so their cooperation is valued. ORers simply noted the "need to communicate with clerks, to get the data", and "you need good relationships with the client's department, to get access to data and background information". In fact, the importance of being able to get information was *expressed* more heavily in the case of 'other' stakeholders than it was in the case of problem-owners themselves.

Difficulties can occur when the information is sought from people who are personally involved in an area of the clients' business which is under study. There is sometimes a suggestion of culpability in 'analysing' someone else's work, without their request. One ORer noted that these 'informants' "require special interpersonal skills, because it's not their project", but did not specify what these skills might be, or how they might be acquired. Another practitioner advised "be straight with them, and ask for their cooperation". This 'honest' approach was also endorsed by the first ORer who approaches stakeholders and informants by saying things like

> "okay, we know this isn't the greatest thing as far as you're concerned, but we've got to do it .."

Another said

> "make it clear what you're after - you're not there to do them out of a job".

The first ORer also adopts an 'act dumb' approach, saying

> "Can you tell me about so-and-so? I'm learning about this; I'm new in this area. Can you help me?"

The connection between personal relationships and information has been made in OR literature, though again this is often anecdotal. Rees (1981) claims that much OR work fails because OR consultants have not talked to the people who *know* how the organisation works - namely people at 'grassroots' level. Rivett (1983) argues that

> "operational research scientists should spend as little time as possible in their offices and as much time as possible in the dirt and the muck and the noise and the chaos of the real world".

A significant factor in ORers' relationships with other stakeholder is, what Williams (1983) calls, "the 'you're on their side' hang-up". ORers in this study recognise that they must not be seen as "high-flyers", or as being on the management's side. This point was also eloquently made by Banbury (1968), who advised that OR "should not appear to be

the stooge of senior management, used by them as a means of policing their subordinates". In this regard, ORers' relationships with stakeholders are similar to those with senior (remote) sponsors, where the aim is not to be seen as offensive or opposing.

Interpersonal skills are helpful in situations where information is sought. However, in situations where a project outcome *does* reflect badly on a particular person or group, or where it seems likely to lead to disadvantageous changes, from their point of view, ORers' approach needs a bit more depth. The consultants in this survey genuinely seemed interested in collaborating with stakeholders, as well as with clients, in working through 'problems'. One stated that factory workers accept OR's role (as a service to management), and are cooperative if they believe the ORer can, and might, help them to cope with the project outcome. This consultant appeared less concerned with projecting an image of impartiality, and more concerned with identifying with workers on a personal level - thus projecting an image of being a friendly face in the 'opposition camp'. To this end, he often pays informal visits to the factory, and described an example of a project where he had tried to ensure that workers' version of the 'problem definition' was represented in debate.

8.4 Dealing with Conflict

The 'normal' processes by which organisations resolve or otherwise deal with conflict are described in chapter 4. To a large extent, OR practitioners in this study did not feel that they had much to contribute to these processes. This is mainly because their problem-helping efforts are directed towards the concerns of a single decision participant, or a coalition of participants. [Alternatively, it could be argued that this

orientation is chosen in order to justify their avoidance of conflict.] Where ORers do have further involvement in social decision processes (see section 6.4.3), their approach to potential conflict could be described as *helping their client to 'win the argument'*. However, ORers were asked about their approaches to handling conflict, and the following picture emerged:

Three practitioners spoke of projects where their reports had indicated "different points of view on some issue" ("you certainly don't present a one-sided case"). However, one described the decision participants' response in the following terms:

> "they accepted the fact that they weren't happy with everything in our report; they used the bits that backed up *their* case, and ignored the rest".

Another practitioner cited an example where OR had attempted to make a greater contribution to resolution of a conflict between managers. He said

> "we felt the most important thing to do was to bring the conflicts out into the open .. We produced a huge report which described how the system worked, and described where the conflicts existed .. [but] I'm not sure we did much about it in the end".

Two practitioners felt that ORers' best chance of making a contribution was due to their *neutrality* - ".. the fact that you can step back from it, see it in the round". One ORer considered that he was "well respected" by various different departments. He also hoped that he would be able to "elucidate" different points of view - to "search for synthesis .. common strands", and to "gradually move people into a common position".

8.5 Problem-Helping Relationships

In section 8.1, above, I explained that OR practitioners in this study seemed primarily concerned with developing and maintaining relationships with clients in order to ensure access to the arenas in which their problem-handling activities take place. I criticised this attitude on the basis that these consultants had previously expressed collaborative work as an ideal, but paid little attention to the practical business of working through problems *with* clients. However, it is clear that these ORers are concerned with living out on-going problem-helping relationships with the clients, and regard relationships, of various kinds, as fundamental to the nature of their consultancy work. In the following sections, I will consider how OR work can be described in terms of these relationships.

Traditionally, OR has been described in terms of what takes place during a single project. Projects are, as Pidd and Woolley (1981) put it,

> "the discrete units in which the OR product is sold to the rest of the organisation. Projects are used by various parties to control the progress of the research".

Bryant (1988) describes projects as "an administrative convenience" that is "eminently 'sensible'". The use of 'the project' in this way is not in question. However, there is evidence to suggest that the process by which OR work is carried out can usefully be described in terms of *relationships* which transcend individual projects. Here, a project is "a stage, possibly an important one, in an unfolding relationship between the parties concerned" (Bryant, 1988).

All of the ORers in this study described how projects are imbedded in ongoing relationships, and how social networks are the source of new work:

> "The people who use OR tend to be the people who *have* used OR";

> "We tend to work in certain areas where we've built up a relationship";
>
> "Work comes in from individuals who know us".

Most simply, a project may proceed from a previous one with *the same problem owner*. [See Conway (1977) for an explanation of the psychological processes by which a client develops 'new' problems.] Some of this work is so closely related to previous work that it is referred to as 'maintenance' or 'updating'. Indeed, it is quite common for such work to be carried out without officially beginning a new "project".

Alternatively, relationships may yield further projects in *different* problem areas: One OR practitioner in this study explained that

> "follow-on work is usually obvious .. you follow on because you've got a set of contacts .. talking over their problems over lunch .. and [a client] says 'I have now got such-and-such a problem, have you got any thoughts about it?"

Another practitioner explained that often "they'll ring you up about one thing, and then mention something else". A third practitioner explained that his projects "blend seamlessly" into one another. Eden (1989) describes the deliberate way in which the "SODA" (Strategic Options Development and Analysis) methodology accounts for the "follow-on" phenomenon: here, the development of a "strategic map" yields "clusters" which often become the subject of further work, whose attraction "lies in the clear understanding that it will be carried out within the context of broader qualitative issues".

In view of the fact that OR work involves a more complex social network than merely a single client and consultant, it should not be surprising that an OR consultant's relationship with various social actors can spawn projects. As the ORers in this study described the sources of project work, and the nature of their consulting profession, they invariably found it easier to refer to work done 'in a particular *area*', rather than necessarily for a particular client. This may mean a

geographical area, a *functional department*, or some other subset or suberin within the client organisation.

I noted that a "problem-owner" may often be a small coalition in or around a particular department; such a coalition may qualify as an 'area' in this sense. One OR worker said that most OR projects are "variations on a theme", meaning that most projects have some *similarities* or connections to previous projects. These projects may have the *same* sponsor, or may be sponsored by someone *within a function* which has sponsored OR work before. The locus of problem-*ownership* may have shifted within the department. This ORer referred to "*fashions* of working in a particular area" for about one or two years.

Another ORer explained that in one area of his work, a regular meeting (involving clients and consultants) is held to oversee OR work which is being carried out as several different projects. These interactions serve to control and facilitate progress that is being made within a consulting relationship, rather than merely within a single project. On other occasions, projects develop from involvement with people in a working party. Again, the locus of concern may be have changed since the earlier project.

A third OR practitioner in this study referred to "streams of work" involving people (clients) whose interest in OR work transcends individual projects. Of these people, he said, "I would have no compunction about ringing up and saying 'Hi! Remember me?'". Another ORer explained that connections between projects may exist because *data, information, or a computer model* is common to two or more projects. However, this ORer is involved in more computer-related 'maintenance' work than the others in the study.

In three of the OR practices that are being considered in this research, there is some form of *organisational* or *administrative* connection between OR consultants and clients (or groups of clients) which undergirds a series of projects.

This connection is perhaps most obvious at British Coal where OR work has been administered as "fields of work" as well as projects (Tomlinson, 1971). This requires a conscious focus on "reaching agreement with management on the future development of the work" (Tomlinson). Mitchell's ideal for OR is expressed as a "continuing research programme" (Mitchell, 1980).

Some projects arise because a problem owner has learnt, via social networks ("the grapevine") within the client organisation, that OR practitioners may be able to offer some help. This is a more indirect source of project work than that described above, but it is still based on *relationships*. ORers in this study described projects which are similar to previous ones, in terms of the nature of the problem, but which are carried out on behalf of clients who have a 'parallel' role to that of the original problem owner. Projects may arise because a problem owner is a previous member of an OR group, and is therefore aware of the support that might be available. Projects may be referred to ORers by other consulting groups who feel that it is more appropriate for a problem to be tackled by ORers.

More remote still is the project source described by a local government OR worker whereby elected members raise an issue in a committee meeting which is subsequently taken up by the OR group because someone at the meeting has heard of them. Schein (1969) explains that most of his ('external') consultancy projects arise because someone has heard him give a talk somewhere, or read one of his books. Two ORers in this study said that, on rare occasions, projects had arisen as a result of their circulation of a magazine, report or leaflet describing 'successful' OR work that they had done previously.

The role of OR practitioners themselves in generating projects should not be underestimated. Although ORers in this study claim that clients' *ownership* of problems is the basis of their work, it is clear that they feel that, in many cases, their relationships with clients gives them the opportunity and the

right to *suggest* problems. As one ORer put it:

> "If we perceive a problem somewhere, maybe an unstated one, or one that somebody isn't sure that they've got, we can go in there and spend a bit of time showing this person that things are not as wonderful as they might be".

This is consistent with the nature of problems as described in chapter 5 in so far as they are thought to have an observable, objective, *core*, and in so far as they are socially 'negotiated' between a number of social actors, *including ORers*, according to their power within that part of the organisation.

In the experience of the ORer quoted above, it is typical for projects to follow on from one another, *and* to be initiated by the OR group. Senior OR workers, who may be called "section leader" or "project leader" often have the task of "getting work" as an explicit part of their job descriptions. OR managers are also often very involved in marketing their 'service'. One OR worker in this study told a story about a former OR manager who was

> "standing at the coffee machine when a man came out of an office that he'd never seen before [sic]. The OR manager introduced himself - 'I'm the OR manager, can we have a chat?' - and a project came out of that!"

The present OR manager in that organisation still "goes out like a rag'n'bone man, sometimes".

Sections 8.1.3 and 8.2 include references to the ways in which ORers may attempt to develop relationships with particular managers in order to secure future project work. All such efforts are based on a view that ORers provide problem-helping support within ongoing relationships, rather than merely on a project-by-project basis, and that ORers can have a *proactive* role in this relationship.

From the above discussion, it is clear that most, if not all, projects can be described with reference to some sort of a

relationship between OR workers and clients. Nevertheless, the 'classical' way of describing OR methodology uses the 'project' concept, rather than a relationship, to give it its basic shape. Bryant (1988) considers "the dominance of the project concept" to be regrettable:

> "these episodic descriptions transparently fail to highlight what is perhaps the most important feature of any project; its occurrence as a manifestation of an ongoing relationship between those individuals which it involves".

Further, "it is only within the setting of the developing relationships between those involved, that the process choices within a project .. can be appreciated". One explanation, for the "dominance" of the project concept, is that most prominent authors on OR methodology are academically based, and are only able to carry out external consultancy work. Consequently, their form of OR consultancy involves relationships that are relatively sporadic, and projects which are more easily articulated.

The chapter on the nature of the problem-'solving' consultancy that OR provides suggested that the contribution which ORers make to clients' problem-handling and decision-making processes is not necessarily made on a distinct project by project basis. The OR practitioners in this study are concerned to provide their clients with *long-term* problem-handling support, such that their (the ORers') skills are continually being fed into these processes. This kind of support can only be provided through a continuing *problem-helping relationship* between decision makers and OR workers.

8.6 The Research of Conway and Holland

Research carried out at Hatfield Polytechnic between 1976 and 1990, by Duncan Conway and Jane Holland, has much to contribute to this discussion about problem-helping relationships and projects. It is wise to consider the research programme as a

whole, rather than looking at the PhDs of Conway (1984) and Holland (1989b) separately. There are two reasons for this:

1 Much of Conway's work is concerned with developing hypotheses about OR practice, and developing frameworks for describing and acting upon OR practice, whilst these ideas were not subjected to rigorous empirical tests until much later;

2 Holland's work began by making several adjustments to Conway's results, as a consequence of improved research methods.

I shall summarise the research programme, critically, and then consider its implications for interpreting data collected during the present research, and consider how this research's results compare with those of Conway and Holland.

8.6.1 Conway's research

Conway was principally concerned with describing OR practice in a way that reflected interactions between OR projects i.e. connections between past, present and future OR work, and with using this description as a tool that could be used to advantage by OR managers. He developed the "Dynamic model" of the process of OR through "personal participation in this process and external observation of others participating in the process" (i.e. a longitudinal study of two OR groups). Each project can be described in terms of its relationship to previous projects in one of the following ways:

0 - **external stimulus** - project arrives 'from nowhere'

1 - **repeat work** - project follows on from previous work for the same manager

2 - **internal linkage** - project stems from unrelated work for the same manager, or from similar work for a different manager

3 - **external linkage** - project develops from apparently unrelated work, via 'the grapevine'

4 - **selling** - OR persuades a manager to work on a project

5 - **research** - OR sponsors a project itself

These six project types can be represented pictorially as follows:

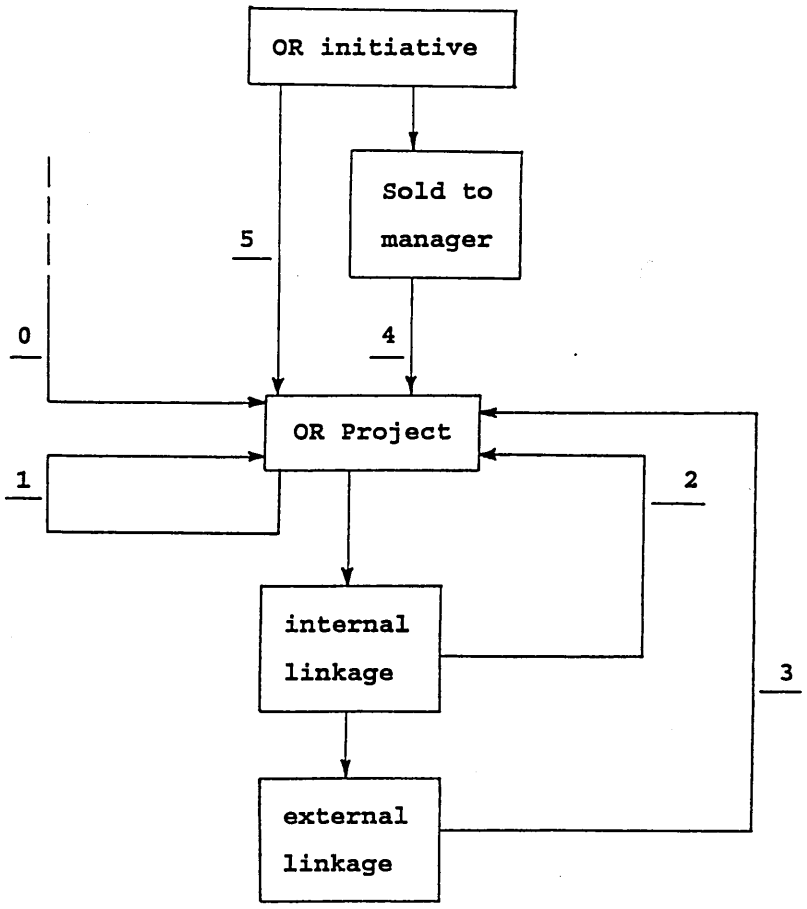


Figure 5

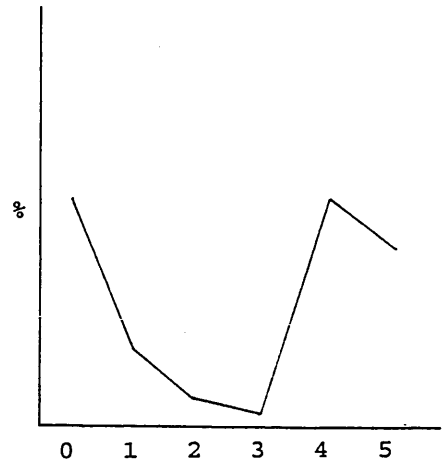
Conway analysed popular descriptions of the 'OR process'. As I have noted that ORers spend much time doing "maintenance" work, to promote a long-term problem-helping 'service', it is worth noting Conway's comments on the concept of "controlling the solution" which often followed a phase called "implementation" in popular textbook descriptions of OR: he remarks that this was originally a "recognition that, given that the environment of the solution is dynamic, it is essential to keep reviewing the solution" (Conway, 1984). In recent years, Conway argues, this meaning has been lost, thus making the methodology "even more static".

Although Conway did not subject his dynamic model to extensive empirical testing, we may accept its validity. It has survived the subsequent fieldwork by Holland, and is generally considered to be an insightful way of describing consulting relationships. The ORers interviewed in my research also found the various categories of project to be meaningful. However, my findings suggest that the distinction between 'OR initiated' work, and 'follow on' work, may not be as clear cut as Conway's model suggests. It appears that ORers are actively promoting the possibility of future work in many of the projects that are described as "internal linkage" or "repeat work".

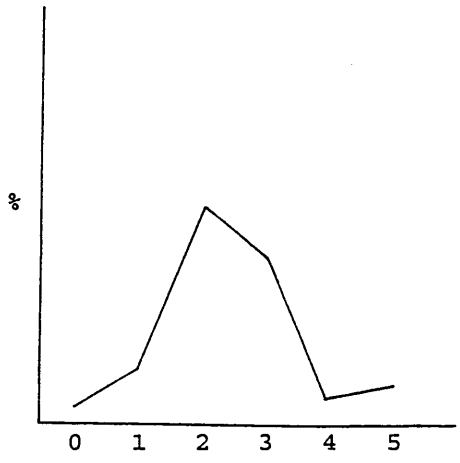
Conway went on to suggest that the

> "stage of development of an OR group, and of the particular field of work being considered, will affect the mix of projects. During the early, pioneering stage of development of an OR group, projects of type 0 and 4 will dominate. With growing acceptance of OR by the organisation, repeat and related work will start to grow and work of types 1, 2 and 3 will increase. With maturity will come a greater control over the use of the group's own resources so that projects of type 5 will in turn start to appear" (Conway, 1987).

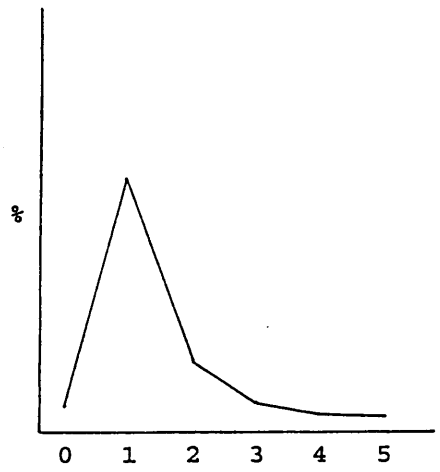
Each OR group, then, can be described by a *project profile* such as those in figure 9, below. A project profile measures the percentage of each group's projects which fit into each category.



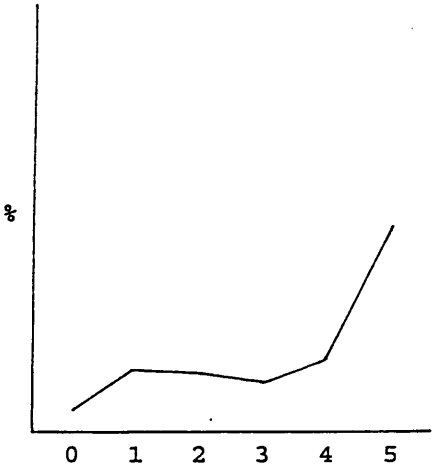
Pioneering OR group



Mature, secure, OR group



"Niche" specialisation - much work in one particular area



Little client-initiated work

Figure 6

Whilst this appealed intuitively, Conway recognised that his ideas needed to be tested, and that, if the model was to be useful to OR managers, it needed to be understood in the context of a theory about success and failure (in some sense or other) of OR. He developed the idea of the *life cycle of an OR group*. This model was based on that of Pettigrew (1975), which had been based on longitudinal studies of one systems analysis

group and one O & M group. Conway's version comprised the following phases:

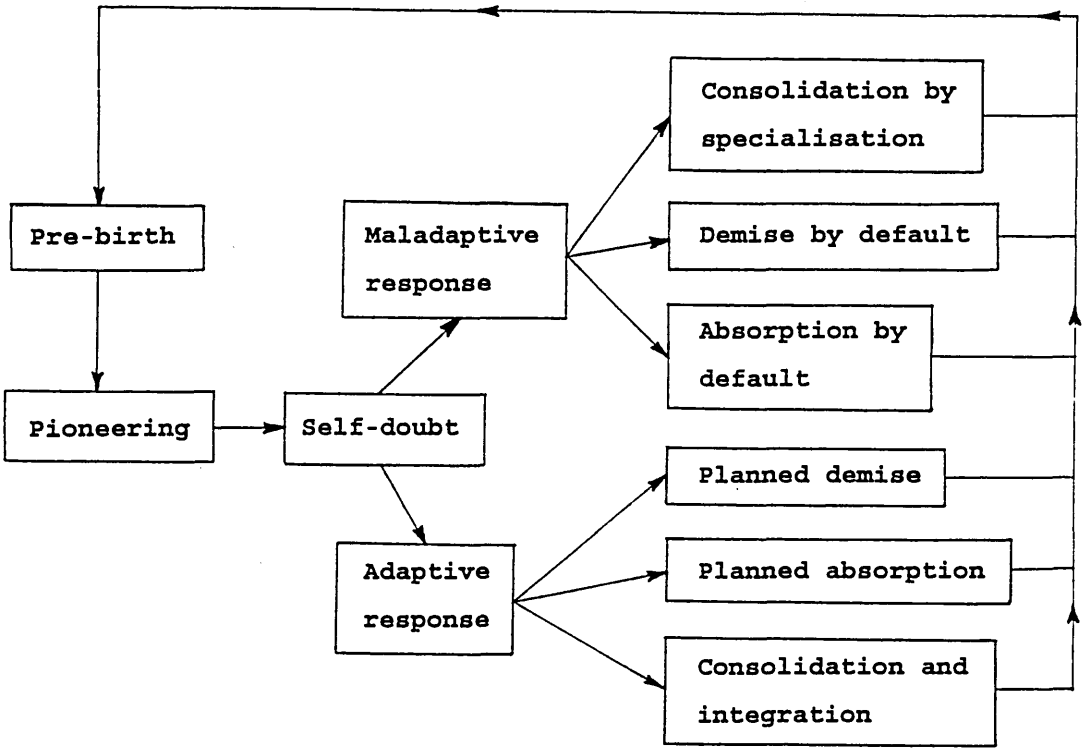


Figure 7

The model was later developed to include *dynamic equilibrium* and *niche specialisation* as adaptive responses (instead of "consolidation and integration"), and to include *complacent specialisation* as a maladaptive response (instead of "consolidation by specialisation"). See Holland (1988, 1989b).

Conway studied 27 OR groups, compiling a *project profile* for each group. He then placed them in a position on the life cycle on (what he describes as) "a subjective, conventional basis" (Conway, 1987). Holland (1988) suggests that the factors considered were "stability of personnel numbers, integration with the parent organisation, level of management support and subject matter and techniques used in projects". Conway states that "trends .. can .. be discerned" whereby OR groups at the various positions on the life cycle (placed by

Conway's subjective assessment) have project profiles like those that would have been expected under his hypothesis. In compiling project profiles and using them in this way, Conway assumes that *'a project'* is a valid basic unit of analysis. This is considered to be "an accurate quantitative measure" (Conway, 1987).

8.6.2 Holland's research

Holland describes the achievements of Conway's research in the following terms: "as a first proposition there were not too many serious flaws. .. Practitioners are starting to realise that there are different types and mixes of project, and to recognise the relevant advantages of each sort" (Holland, 1988). Holland set about investigating the original data set and research methods, and subsequently carried out a further survey of OR groups to test the validity of Conway's models as predictors of OR groups' success.

Holland considered Conway's original classifications of OR groups to be "somewhat superficial" (Holland, 1988). Whereas Conway believed that project profiles matched what was expected for groups at their respective positions in the life cycle, Holland states that "the numbers did not seem to tally with this statement". She noted "major fluctuations within the classification". She also noted a time bias in the way that projects' origins had been measured. Holland attempted to identify *clusters* of groups whose project profiles *did* match those expected under Conway's hypothesis, and consequently re-classified 7 of the 27 OR groups.

Holland then attempted to contact each of the 27 groups to see if their project profiles supported the predictions about the group's life that would have been made by their original positioning on the life cycle. At this point, it is important to note that the life cycle concept does not explicitly refer to the *time* that groups might take to move around the cycle.

When some groups were classified according to their "demise" or "absorption", this was a *prediction* of the groups' 'fate' at some (unspecified) later point - the demise had not already taken place at the point when Conway conducted his fieldwork. Holland's assessment of the accuracy of these 'predictions' *appears* to be a comparison of the project profiles constructed in 1980 by Conway and in 1988 by Holland, although this is not entirely clear from Holland (1988).

By 1988, Holland had made contact with 17 of the 27 groups, and had been able to compile project profiles of 7 groups, and a later publication (Holland, 1989b) suggests that more data may have been collected. Holland estimates that 12 of the 27 'predictions' were wholly or partly correct, although this is obviously not *all* substantiated by the results of her survey. The survey returned 5 out of 7 predictions correct. Two groups were known to have 'demised', as predicted. The other 5 "correct" predictions were, presumably, based on anecdotal evidence.

The purpose of Holland's survey was to *validate* the models developed by Conway. The previous paragraph indicates that she collected some favourable evidence. However, Holland (1988) also used the data to make comparisons between OR practice in 1980 and 1988. She claims that there is "a significant shift in the character of British OR" (Holland, 1988). It is clearly unacceptable to use the same data for both purposes.

[The comparisons between 1980 and 1988 were based on the results from six OR groups. It should be noted that, although Conway's original sample was considered "representative" (Conway, 1987), this may not apply to the six remaining groups. In particular, Holland notes that "some groups were not happy with the way they had been classified in the 1980 survey, taking exception in the main to the phrase "maladaptive", and because of this were not encouraged to help again" (Holland, 1988) She also notes that "groups may not have included their failed projects on the form".]

I have dwelt at length on the methodology and results of Conway and Holland's research. I hope it is clear that the validity (in the empiricist sense) of the models developed by Conway depends upon the results of Holland's study. [The dynamic model and life cycle must be stand or fall *together*, since the former was not initially established by rigorous empirical study.] I have already referred to a number of methodological problems or errors, notably a systematically biased sample and a heterogeneous basic unit of analysis (the project). Holland recognised that "project type alone has not proved wholly satisfactory for defining an OR group's position on its life cycle" (Holland, 1988), and determined to develop the model further.

I suggest that <u>the OR community's positive response to the models offers greater support for the models than the empirical studies so far</u>. By this, I mean that practicing ORers (particularly OR managers) may judge the research by its *utility* in describing their working lives, and helping them to direct or influence their lives in a desirable way. Conway claims that the dynamic model, in conjunction with the life cycle,

> "provides the basis for a prediction of the future path of development of the group, and so gives early warning of potential future problems in time to allow corrective action to be taken" (Conway, 1987).

There are, however, a number of practical difficulties which confront anyone trying to use the model in this way:

Firstly, as Tomlinson puts it,

> "project selection has been subjected to a good deal of theoretical analysis, most of which starts with the assumption that a list of possible projects exists which is greater than the number that can be undertaken"

but, in his experience at the NCB,

> "there has never been a long list of projects to hand at any one time" (Tomlinson, 1971).

In contrast, it seems that OR managers and practitioners have to be *opportunistic* in their approach to generating projects.

Secondly, if such choices among projects did exist, it would be difficult for OR managers to justify turning down projects on the basis that 'it will spoil our project profile'! Even if an OR manager is skilled at making excuses for not undertaking undesirable projects, this could have a damaging effect in the long term. Tomlinson comments that "once you say 'no' to a project, the sponsor is unlikely to ask you to take anything else on". This would not be consistent with the 'client-centred' approach which many OR practitioners espouse and desire.

Thirdly, and perhaps most importantly, it seems that the most likely corrective action that an OR group might want to take would be to increase the proportion of internal and external linkage projects (project types 2 and 3) in order to reach the "dynamic equilibrium" which is the 'ideal' position in the life cycle. Ironically, these projects are not (according to Conway) initiated by the OR group, so it is not obvious what the OR manager and practitioners could do to improve the situation. Only project types 4 and 5 can actually be initiated by the OR group. Instead, the proportions of these types of work must be increased by ORers by developing close relationships with clients, and by carrying out project work effectively, thus encouraging further requests for work from those clients, and improving the OR group's image abroad the company. My research suggests that OR practitioners *can*, in fact, do much to promote repeat and internal linkage work.

8.7 Aids to Strategic Management in OR

It is interesting to note a similarity between Conway and Holland's 'life cycle of OR groups', and the concept of the 'product life cycle' which has been widely used as an aid to

strategic marketing (eg Smallwood, 1973). The product life cycle is based on the idea that a product has a 'life' in the marketplace. This life can be described in terms of five stages: introduction, growth, maturity, decline and termination. Marketing managers can make judgments concerning the product by considering its position on the life cycle.

There has been some criticism of the concept of the product life cycle (eg Dhalla and Yuspeh, 1976), much of which is based on "the lack of correspondence between the marketing and the biological worlds" (Dhalla and Yuspeh). [Similarly, Conway and Holland do not suggest *why* OR groups might, or should, have a 'life cycle'.] An over-reliance on the life cycle concept can lead managers to neglect existing products in the fatalistic belief that 'they have had their day'.

Another similarity with a popular strategic marketing tool can be discerned in Keys (1991b) analysis of the life of two OR groups, following Whiteman and Wise (1981) and Sitruk (1983). Keys describes the groups in terms of two factors: the level of sophistication, and variety, in their techniques; and the confidence that the host (client) organisation's managers have in OR. These factors can be combined in a two-by-two matrix as shown in figure 8, below.

The Boston Consulting Group's 'growth-share matrix' (Hedley, 1977) has a similar shape (see figure 9). On the vertical axis, it has the rate of growth of a product's sales (which, like 'variety of methods', is a sign of vigorous, and intensive development); on the horizontal axis, it has the size of the product's share of the market (which, like 'management confidence', is a measure of the solidity and loyalty of custom which a product enjoys).

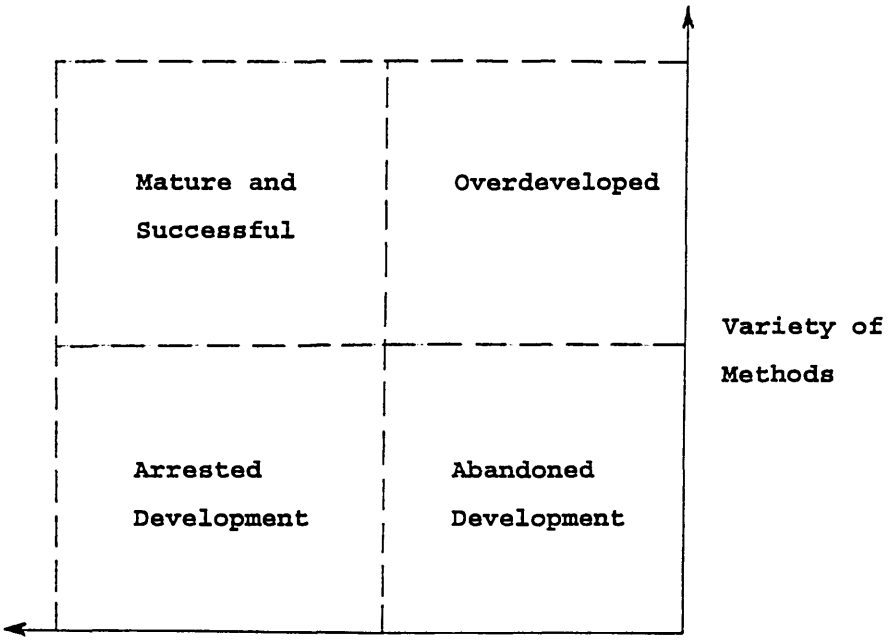


Figure 8

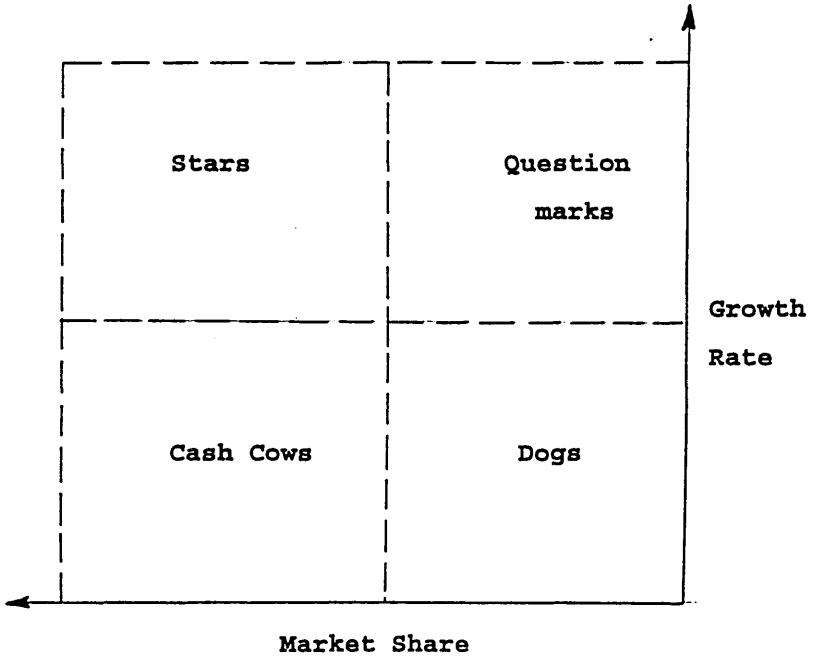


Figure 9

As with the model in Keys (1991b), the BCG's matrix classifies as 'successful' products - "Stars" - those which have high scores on both axes. "Cash Cows" are those products, like Holland's "niche specialisation" or Whiteman and Wise / Keys' "arrested development", which are no longer thought to present opportunities for investment. "Dogs" are those products, like Whiteman and Wise / Keys' "abandoned development", which are considered to have no future. "Question-marks", or 'problem children', are those products whose future is uncertain, due to development which is not yet matched by loyalty of custom.

The use of the growth-share matrix is different from the use of the model of OR groups' status: the growth-share matrix is used to depict a product portfolio, so that cash flow can be regulated by an appropriate balance of products at different points on the matrix; the model for OR groups simply offers a way of describing four different states in which a single OR group might find itself. However, Conway and Holland have already shown that the state of health of an OR group can be described, reasonably accurately, in terms of a portfolio of projects. It is therefore possible that the growth-share matrix, or Keys' version of it, could be used to chart the 'portfolio' of work that an OR group is carrying out at any point in time.

This is a simple idea, but it would need to be developed further if it was to be put into practice. Attention would have to be given to dividing up the project portfolio into meaningful units: the notion of an individual 'project' is unlikely to be sufficiently robust, whilst the idea of 'fields of work' is perhaps *too* broad to be used as a unit of analysis, since OR managers may want to ensure a balance of projects *within* a field of work. In any case, it is encouraging to see that OR workers, who aspire to promote their clients' business interests by the explicit use of conceptual models, are on the verge of using the same kind of approach to help in the development and regulation of their own profession.

8.8 Summary

OR practitioners *value* relationships with their clients. It is through *ongoing relationships* that they are able to make the *continuing* contributions to problem handling described in chapter 6.

ORers are principally concerned with establishing relationships which can ease the difficulties which face *them*, as consultants. This applies to the *short-term* process of reassuring *problem owners* of their competence and trustworthiness during a particular project. It also applies to the *long-term* process of generating further business. ORers may take a *pro-active* role, here. ORers appear to be relatively unconcerned with developing relationships so that they can understand their clients' *needs*, even though they recognise clients' need for assurance. Thus ORers' consulting paradigm appears to be partially in conflict with their *espoused* altruistic ethics (see chapter 3 and section 8.1).

Relationships are developed through *informal contact* during, and in-between, project work. ORers are conscious of the *image* they are projecting. Some ORers also attempt to further relationships (often with sponsors) through *public relations* exercises.

Relationships with other *stakeholders* are also geared principally to overcoming consulting difficulties. Here, ORers project an image of neutrality and fairness.

ORers may *not be able to intervene* in their organisations' normal processes of conflict 'resolution'. Because of their particular devotions to problem owners and sponsors, ORers' contributions are usually aimed at strengthening these clients' hands.

Relationships may be viewed as the basis for ORers' problem-helping activities (as described in section 6.4). OR practitioners and, particularly, OR *groups* have ongoing problem-helping relationships with many different clients. There is some evidence that attention to the *portfolio* of projects generated through these relationships, and/or the portfolio of relationships themselves, may aid strategic management of OR.

Chapter 9

APPLICATION OF O.R. TECHNOLOGY

This chapter draws together the strands of thought that have been followed through the last three chapters, on problem-solving, technology, and relationships, respectively. I shall consider the ways in which OR practitioners *apply* their characteristic methods and technology within the problem-helping relationships with their clients. In terms of the pyramidal model of OR practice, the subject of this chapter is 'three-dimensional' i.e. it relates all four vertices - consultant, client, problem and technology. However, the emphasis is on the use of technology, so the relationships between technology and clients, and between technology and the problem-helping process, are the main foci.

The chapter begins with consideration of the ways in which the technology described in chapter 7 is used within, and to aid, the problem-helping process. The first sections covers the application of technology within various 'stages' or 'elements' of the process. Next, the nature of practitioners' *choice*, from a repertoire of methods and technology, is considered; choice criteria, and appropriate techniques are discussed. The chapter concludes with an attempt to make *general* statements about the relationship between OR's technology / structured approach and the real, social, world of problems, in which ORers intervene.

9.1 Technology and OR Process

In-depth interviews were used to explore the use of technology in the OR process of problem-helping. This part of the study

was concerned with the entire technology/skills spectrum, but the results described in this section apply largely to *tangible* technology, such as computer models.

ORers were asked about the technologies and skills that they use during various 'stages' in a typical OR project. These stages were as follows:

(i) Inquiry into a problematic situation
(ii) Description of a problem
(iii) Analysis
(iv) Presentation of results or ideas
(v) Implementation/debate/decision

In the interviews, I expressed my reservations about the accuracy and reliability of this archetypal project of five or so 'stages'. Rather, these five activities should perhaps be regarded as 'elements' of OR practice which are connected logically, though not necessarily chronologically. I suggested that it could be taken as 'given' that a *problem-solving consultancy* activity such as OR comprised (at least) these five activities (though a single project, could conceivably emphasise some activities more than others). The interviewees appreciated this, and were happy to try to describe their use of expertise in this way.

Following the fieldwork and subsequent analysis, it is possible to go further. I have described problems in terms of personal trauma imbedded in the organisational processes of decision making, usually in the individual processes of proposal formulation. We can, therefore, attempt to expand on the five elements of problem-helping to reflect the centrality of clients' experiences in organisational decision making.

Friend and Hickling (1987) have described the process of working with problems in terms of six elements:

scanning
shaping
designing
comparing
choosing
doing.

This relates to their view of problems as "situations where one or more decision makers are having difficulty ..", which is compatible with the findings of this research. This framework can usefully be merged with the five-element one described above. However, some adjustments are necessary because of Friend and Hickling's emphasis on *collaborative* work, and corresponding under-emphasis on the *consultant-client distinction* which is clearly maintained in most OR work, despite the collaborative aspirations of OR practitioners:

(i) An OR consultant aiming to aid decision-makers will make an *inquiry* into their situations, rather than scan his own environment.

(ii) He will also *'present' findings / thoughts* to his clients. Together, inquiry and presentation represent the communication that goes on between consultant and client.

(iii) Because of the trauma (i.e. because decision making is problematic), the consultant is expected, and expects, to *do* something. We have seen, in chapter 6 on problem helping, that this "something" can include prodding, improving clients processes etc., but often includes explicitly *addressing* an object system. This we may call *analysis*.

(iv) In view of the fact that problems are usually imbedded in an individual's formulation of proposals, we need to distinguish between intellectual processes of *proposal formulation* (and help with this), and social processes of *negotiation* which lead to a choice commitment.

This gives us:

Inquiry
Description / Shaping / Designing
Analysis and Comparison
Presentation
Choosing proposals

- -

Social processes of negotiation
Decision commitment
Doing.

These activities do not necessarily happen in the linear sequence shown. However, there is a *logical* sense in which the process necessarily begins with inquiry. In view of the fact that OR practitioners' efforts are directed towards aiding an *individual's* process of proposal formulation, it is possible to distinguish between the first six activities (from inquiry to choosing proposals) which involve consultant and client, and the last three activities which *principally* involve the client and his colleagues.

This list of activities can be used to examine OR practitioners' use of technology during the process of helping decision makers with problems.

9.1.1 Inquiry

The notion of *initial inquiry* into problematic situations proved quite difficult to use in interviews, as the following excerpt illustrates:

Q: "when you're initially exploring a situation, what skills / technology do you use?"

A: "It depends what the problem is."

Q: "You don't know that though, do you?"

However, further questioning revealed that OR practitioners' approaches to using technology as an aid to making an inquiry appears to be quite enterprising. However, their approaches seem to depend upon *developments of suitable technology*, and have little to do with *deliberate consulting strategy*. Common technological aids include:

A prototype computer model
Results from preliminary studies
Models or results from previous studies
Model 'shells' (including spreadsheets etc.)
On-line computer modelling
Graphs and maps on paper

All of the above are used as *prompts* in discussions with clients, The rationale here is that clients may be better able to *espouse* responses, and consultants may be better able to *understand* responses, if the responses take the form of *comparisons* with options that can be illustrated using some sort of model. Clearly, *some* notion of 'what the problem is' must guide the choice of 'model-prompts', as the above interview excerpt shows. These models are used during the early stages of a project, after an initial problem definition has been given, but before it has been fully explored. They are also used for 'inquiry' during later stages of a project, as the subsequent discussion will indicate.

The availability of suitable tools has been improved by developments in microcomputing. As Lines (1981) notes,

> "the micro appears to have features which could .. lead to a far more constructive dialogue between the manager and the OR .. analysts".

The introduction of computers fast enough for *interactive* modelling, and small enough for carrying to wherever clients are based, has enabled OR practitioners to benefit from using models *earlier* in the consulting process than might otherwise have been the case.

A major 'tool' for aiding inquiry into problems, and which is widely felt to characterise OR's approach, is what one OR practitioner in this survey called a "structured approach to asking questions". The importance of this tool has been expressed in recent years by writers on 'soft' OR: Cropper (1984) refers to the skill of being able to "ask questions that might otherwise go unasked", and to the use of technology as a "generative frame" or "sparking device" (Cropper, 1987). This latter term seems appropriate to the 'intuitive' use of technology to aid inquiry adopted by ORers in this study. The deliberate, strategic use of frameworks for inquiry is described by Bryant (1988) and by Eden, Bennett and Huxham (1986) who refer to use of "a systematic set of questions" stemming from a coherent theory of problems and problem solving.

The increased use of, and interest in, both soft OR and visual interactive micro-computing suggest that ORers may make increasing use of technology as 'frames for inquiry', and that the appropriate skills will need to be developed and taught.

9.1.2 Description

As with 'inquiry', this section refers to an *element* of OR consultancy practice, rather than a definable *stage* in a project. Nevertheless, an attempt to describe, or *capture*, and issue, situation, belief or value, follows logically from inquiry into the same. The inquiry tool 'systematic questioning' has a counterpart (and its roots) in description: it is the desire and ability to set down an explicit *description* of something which spawns intelligent (perhaps systematic) questioning into its nature. Several ORers in this study used phrases like "building up a picture from the answers to questions" as they described their work.

The building of descriptive models involves a dynamic interplay between *data* and some sort of *framework* which is

used by the OR practitioner "to sieve the data .. and to slot the selected elements into their appropriate places within his organising schema" (Bryant, 1988). Organising frameworks vary in gentleness, and in the degree to which they allow the data to 'claim' its own shape. Such frameworks are rarely made explicit by OR practitioners beyond a superficial level.

As with inquiry, soft ORers have led discussion about the descriptive nature of OR technology: Cropper (1987) talks of "articulation, definition and clarification of issues", and of a model as a "representation of the world or someone's world". Bryant (1989) talks of "setting the problem in some structured framework". Again, the value of this use of technology is being realised, although the ORers in this study seemed to regard description as merely a necessary precursor to *analysis*. Practitioners' perceptions of the descriptive element of their work was mainly limited to an initial statement of 'the problem'.

The most common 'technological' aids to description used by OR practitioners are, not surprisingly, pen and paper and note-taking. This custom is not, of course, peculiar to, or characteristic of, OR work. Some practitioners referred to the use of "systems diagrams" and flowcharts for recording complexity, but they were surprisingly dismissive of this way of working. It is likely that this is due to the assumed *normality* of this kind of approach, rather than to a belief in its impotence.

The only stated uses of computers to aid description involved word processing of a project's 'terms of reference (i.e. computerised pen and paper), and "on-line modelling" (APL programming in interactive mode). However, my analysis of ORers' technology (in chapter 7) showed that ORers make considerable use of spreadsheets, and also some use of databases and expert system 'shells'. These computer-based resources provide a basic language or framework with which ORers can assemble *descriptions*. I commented, in chapter 7,

upon the prevalence of *non-optimisation* techniques such as "financial modelling", "data modelling". Whilst these terms may encompass some minor analytical tools, it seems that their role is largely one of *description of complexity*, rather than analysis. *What* is described may be *a situation*, a *part of* a situation, or *data that is relevant to* a situation.

A popular form of framework used by ORers is a simple system of business concepts such as "objectives", "constraints", "resources" etc. which are commonly thought to be the essential parameters of a decision-making problem. They are also the essential parameters of an optimisation approach. However, as I have already noted, optimising *techniques* are not prevalent in OR practice, so the popularity of this kind of framework merits an explanation. One possible explanation is that formal techniques do not (attempt to) encapsulate the *reality* of the entire problem-solving process, so techniques need not take the same shape as the process itself.

9.1.3 Analysis

As OR practitioners in the pilot study (and subsequently in the main study) defined their roles in terms of providing *analytical* help with problems, I enquired about practitioners use of technology in some kind of analysis. Several ORers stated that "most of the technology" is for analysis, particularly "the hardware". Indeed, it is so often taken for granted that OR's technology is used for analysis that I have felt it necessary to make explicit reference to its use for other purposes.

I am using the term "analysis" to mean *manipulation* of two kinds:

- of a description (of a situation)
- or of a set of *data* which is relevant to this description.

In the first type of analysis, technology is addressed to *descriptions of the problem itself*, i.e. analysis of the data which, as an output from the inquiry 'phase', actually *defines* the nature of the problem. The OR practitioners in this survey all spoke (some with affection) of using a "structured" or "analytical" approach for precisely this purpose. I have described this approach, as fully as possible, in chapter 7.

People generally express themselves (and consequently express their problems) in *qualitative* terms, yet most of the common "techniques" listed in chapter 7 (apart from the 'structured approach') involve ordering and manipulation of *numerical* data. Expert Systems is the only technique favoured by OR practitioners in this survey which actually manipulates qualitative data.

During the course of this research (i.e. 1987 - 1992), there has been a notable increase in interest shown in qualitative techniques. Amongst the most popular (in the sense of 'generating interest' rather than 'being used') are Cognitive Mapping, Soft Systems Methodology, and Strategic Choice (which are all summarised in Rosenhead's 1989 book), and Neural Networks (eg Masson and Wang, 1990). However, none of the practitioners in this study spoke of augmenting their structured approach by using these technologies, or others designed for qualitative analysis.

In contrast, much analysis done by ORers is *quantitative* analysis, whose *results* may inform the decision process. Analysis may serve this purpose by performing an *evaluation or comparison* of clients' prospective remedial actions. The archetype of this form of analysis is Decision Analysis in which various 'options' are measured according to certain criteria (Watson, 1982).

ORers in this study use a number of techniques which involve *manipulation of quantitative data to facilitate understanding of qualitative aspects of an object system*. Simulation,

linear programming, and statistics, for instance, may be used in this way. In particular, simulation is used to provide an *artificial world* within which *experiments* can be conducted.

Many of the other 'techniques' listed in chapter 7 (data modelling, financial modelling, simple statistics) involve manipulation of quantitative data, yet they often involve such basic calculations that it is flattering and misleading to call this "analysis"; *"computation"* is a better word.

Under the umbrella of "data analysis" comes the collection of this data. One practitioner in this survey referred to the use of survey design as a technology for this purpose. However, it seems that in many OR projects data is used which has already been collected (through survey or routine), and the ORer is left with the task of accessing the data via computer terminals, or via an accommodating clerk or secretary in the client department.

9.1.4 Presentation

In this section, I am using the term "presentation" to refer to all *outward communication*, from an ORer to a client, at any stage in OR work. Presentation is not merely a one-off activity at the end of a project, but is often a way of initiating conversation and stimulating reaction from clients. The inquiry-presentation diad is an essential component of a consultancy framework.

We have seen, in chapter 6, that ORers act as providers of *information* as inputs to the decision process. The development of computers over the last thirty years (Ranyard, 1988, gives an excellent summary) has encouraged this role to mature. The most primitive impact of computing upon organisational life may have been in data processing, for routine purposes, but their use as information systems is now

commonplace (Rohrbaugh, 1987, Sprague and Watson, 1986), and commonly taken for granted.

We can distinguish between "information" and "data" as follows: Information conveys a *meaning* from transmitter to receiver; data is a medium through which this is done. A receiver of a message places an *interpretation* on a data set; information management refers to a process whereby a message is accurately coded and decoded so that a meaning is transmitted between two or more parties. Anyone working with computers, as information systems, must therefore behave as a communicator, as well as an analyst. Many ORers, particularly those who cast themselves as consultants, are acutely aware of this, and explicitly attempt to use technology to aid communication in this way.

According to Eden and Ackermann (1989), graphic presentation may be used for two purposes - for "classification" of information, and to make a presentation "decorative and entertaining". OR practitioners in this survey make extensive use of graphs and charts to convey information in an accessible and attractive form.

This may be done within a written report, through an audio-visual presentation, or through a computer model. Where computers are used, the design of suitable "icons", "at the front end", has been facilitated by the development of high-resolution graphics. In particular, ORers in this survey referred to the use of the "Freelance" graphics package, as well as to visual interactive simulation.

9.1.5 Negotiation and choice commitment

This section serves to 'catch all' activities through which a problem-handling episode may be brought to a climax or conclusion. This may often involve an individual manager making a commitment to a course of action having (hopefully)

taken account of an ORers' input. From the manager's point of view, this may be called "choice"; from the ORer's point of view, it may be termed "implementation". Where decision-making processes are socially more complex, it may be appropriate to talk of "negotiation" or debate.

On the whole, the ORers in this research found it difficult to think about their personal involvement in these activities, let alone to describe tools that they have used on these occasions. Where a computer model has been used to analyse and compare options and their consequences (eg simulation, "what if?" analyses), it is hoped that the *user-friendliness* of these models helps to *engineer commitment* on the part of the client, by removing any distrust of 'expert' computer analysis. This is an extension of the use of graphics (and other) technology for presentation.

The ORers in this survey appear to have little involvement with clients during these choice processes. Indeed, for one, the term "implementation" referred to the *installation* of a computer model. Obviously, an OR worker needs to call upon basic computer engineering skills for this activity. One ORer said "we don't do a post-implementation follow-up; we just assume that they've used it" but added "we're trying to get into that area". This is an example of how a heavy emphasis on computing can distract ORers from focussing upon their clients' decision-making needs, and encourage them to construe problems in terms of *information technology* needs.

Where presentation is done through a written report, it is common for OR practitioners to be involved in discussions with their clients. Where a report is being discussed by a group of decision makers, an ORer is likely to get "dragged in". However, this is usually to explain or re-interpret difficult parts of the report, and to facilitate confidence in its conclusions. Only one practitioner in this survey (and another during the pilot study) could recall an instance where a model (or some other form of technology) was used to

facilitate discussion. He described the situation as follows:

> "that model is actually being used in meetings between ourselves and the unions, and both sides have been seeing the entire consequences of any changes, and both sides are on an equal footing. The consequences of that are a *reduction* of conflict, but we could've been using that, as we have in the past, .. *outside* the meetings so that when a proposition is put by one side to the other, they can go out and say 'what would be the effect of doing such-and-such', and then go back into the meeting .."

This one-off use of technology is like that described by Eden and Jones (1980) whereby a model is used

> "as a device with which the team could conduct a 'dialogue' .. it seems to take away from this negotiation a great deal of the interpersonal dynamics".

This type of approach, now called "group decision support", utilises a variety of tools, ranging from 'low-tech' diagrams and concepts (sometimes illustrated on flipcharts) to 'hi-tech' computer systems. The former include Checkland's soft systems methodology which uses models to "orchestrate a debate" between participants (Checkland, 1985). The latter include GDS systems such as the "Pod" which offers computer support to decision makers who interact with each other directly, and "workbench" environments, in which participants interact via a computer system (Philips, 1987, Ackermann and Eden, 1987). GDSSs offer what Eden (1989) calls a "negotiative device"; he remarks that even 'traditional' OR's more recent tools, such as visual interactive simulation, are designed for analysis and comparison, but not for negotiation.

9.2 Choice of Technology

This section looks at some of the *choices*, about technology use, that are made by operational researchers. I shall consider, first, some features of the project / problem *context* of OR work which must be discerned if appropriate choices are to be made. I shall then look at the decisions

themselves; at the features of an 'appropriate' technology, and at possible modelling strategies. Finally, I shall consider the actual types of technology which are (or could be) used with these purposes in mind.

ORers in this study made only occasional, compact references to choices involving technology. For instance, one ORer stated

> "if you've not got time to write a fancy algorithm, you just throw random numbers at it, and simulate it".

I have utilised this wisdom by considering *why* an ORer might not have time, *what features* of (eg) Monte Carlo simulation make it suitable for such situations, and in what situations would a "fancy algorithm" be more appropriate?

9.2.1 Critical features of the project context

(i) Type of decision:

An OR consultant may be able to judge the (relative) *"urgency"* of clients' dilemmas; in practice, this may be difficult, as clients may perceive all their problems to be urgent. Urgency should not be confused with the *importance* of a decision. An important decision is one whose outcome has far-reaching consequences for the decision-maker, his organisation, or its environment. Both importance and urgency imply certain priorities for an OR practitioner. A decision may be regarded as a *"one-off"* i.e. a decision of this type is unlikely to have to be made again. Alternatively, it may be one in a long sequence of *related decisions*, such that the solution (or the process leading to solution) of the present decision is relevant to future decisions. Alternatively, the present decision may be judged to be related to *previous* decisions.

(ii) Identity of users:

Some aspects of OR methodology concern the relationship between clients and ORers' technology. It is primarily for this reason that this chapter follows chapter 8, on relationships. ORers need to consider which social actors ('clients') are likely to have significant contact with whatever technology they use. This is partly a feature of OR's environment, but may also be considered as a *choice* to be made by ORers.

(iii) Users' technological capabilities:

Depending upon the outcome of the above decision / assessment, ORers need then to consider how well these users could cope with, and use, various technological aids. There are two main issues here: do the users have adequate *"technical knowledge"* to be able to relate to the tools? ; do the users have the *"necessary computer hardware"* (or space, etc.) if a computer model is considered?

(iv) Users' style:

Apart from users' technical abilities, it is also relevant to consider their *"personality" and preferences* if they are to enjoy a productive relationship with the technology. This may include factors such as decision-making style, learning style etc., and also simple factors such as preferences regarding information presentation, layout etc.

9.2.2 ORers' needs and preferences

(i) Analysts' competence:

OR practitioners also have needs and preferences which affect their choice of technology. Most obviously, every ORer has particular *competence and experience*, and may also have

favourite technologies. At any one time, an OR group will only be able to offer the services of *some* of its analysts; these may be allocated to areas of work on the basis of their expertise, or on the basis of their development needs.

(ii) OR management strategy:

OR groups have limited *time and financial resources* which they want to invest efficiently and creatively. ORers (notably those with management responsibility) also try to select technology that is appropriate in the context of their overall, *long-term strategy* for technological development and use. Clients may, therefore, be encouraged to fit in with other broader priorities.

I described, in the previous chapter, how ORers act in-between projects, and in ways that transcend projects, to develop relationships with their clients. Technology can also have a role in the *development of useful working relationships*.

Rather than merely consider clients' technological capabilities, and style, on a project-by-project basis, ORers may seek to *educate* their clients. This can include passing on technical skills, and also projecting a desirable image of OR consultants.

9.2.3 Choices within projects

(i) Availability of data:

ORers must consider their *"data requirements"* and also the *"availability of data"*. A mismatch between the two necessarily implies a change of tack by the OR practitioner. Since all data is ultimately a product of a social process (Graham, 1985), ORers must also consider *"who has the data"*, and what tasks they will need to undertake in order to get it.

(ii) Deliverables to clients:

ORers need to decide what technology, if any, will be 'handed over' to users i.e. what are a project's *deliverables.* This will depend upon the clients' technological abilities, and the nature of the decision. It may be difficult to deliver a reliable model to a client if it has been developed at speed, and is not easy to use.

(iii) Use within the process of helping with clients' problems:

ORers choose (often subconsciously) where, when and *how technology will be introduced* into a problem-helping episode. In general, this will depend upon the role that technology is hoped to play in the problem-helping process (see first part of this chapter). A client may be involved in the developing technology; *client involvement* facilitates acceptance of the technology and its presence in the midst of the client's problems. However, and whenever, technology is introduced, ORers need to be able to conduct three-way conversations between themselves, their clients, and their technology. This is easier with some types of model than with others, and also requires special skills on the part of the operational researcher.

9.2.4 Features of appropriate OR technology

(i) Speed of model:

If a decision is urgent, or if ORers are busy, then they prefer to attempt to use technology which can be *developed quickly*, and which can be used quickly. The OR Society's Commission on the Future Practice of OR (ORS, 1986) found that this is a common situation; practitioners use tools that meet needs as quickly as possible.

(ii) Accuracy:

If a decision is important, then a model which is *accurate* is preferable, so that the chances of a costly error of judgment are minimised. There is often a trade-off between accuracy and speed, thus posing a difficult choice where an importance and urgent decision is anticipated. The Commission's observation suggests that speed usually takes priority.

(iii) Ease of use:

Ideally, any technology should be *easy to use*. However, this is a priority where repeated use is likely, where users may have considerable hands-on use, and where a new relationship with users is being fostered. There is sometimes a trade-off between ease of use and speed of development, and choice hinges on whether or not an ORer "can get 'round to making it user-friendly".

(iv) Adaptability:

ORers may be able to utilise a model that has been developed for related decisions, or may be able to develop models which could later be *adapted and updated* for use with related decisions in the future. In this case, a model must be designed to be *"open to change"*. If a model is required urgently, but may have long-term relevance, ORers may attempt to develop a *"prototype"* model which can subsequently be refined.

(v) Relationship friendly:

Many ORers in this study have found that by carrying out *"minor projects of a relatively technical nature"*, which do not have the problem-helping aspects characteristic of OR, they can become accepted as generally helpful and analytic people. The danger is, of course, that this type of work dominates their portfolio. This is an example of a wider

consideration, namely whether ORers' choice of technology, and the ways in which they present it to clients, projects an *appropriate image* of the nature of their work. On occasions, ORers may deliberately try to impress potential clients with displays of technical wizardry, though this is considered more appropriate to events such as open days than to serious work with clients' problems.

9.2.5 Appropriate types of technology

(i) Simple .. complex:

A model may be termed "simple" if one or more of the following simplifications are made: the *number of variables* in the model may be kept small by limiting the scope of the model; the number of variables may be kept small by making *a priori* estimations of which ones are likely to be significant; the *number of relationships* between variables may be kept small, or simple (eg linear . The arguments for using simple models are spelt out by Ward (1989); simple models tend to be relatively quick to develop, maintain and use. They do, however, compromise on accuracy.

(ii) Generic .. customised models:

A "generic" item of technology is one which belongs to a 'family' of (similar) technology. This applies to models which have been borrowed or adapted from previous ones, models which are designed to be interfaced or integrated with others, models which are developed from 'shells' or other software resources which offer a basic structure. A model may be "customised" if it is designed to suit clients' special needs. Such 'needs' include the precise nature of their decision, their technical capabilities, and their style and personality. Generic models can often be developed very quickly, although the first model in a 'family' may take a long time to develop. By definition, they can form part of an efficient long-term

modelling strategy. However, generic models may compromise on accuracy, and on ease of use, whilst a tailor-made model might contribute to improved client relations. Furthermore, generic modelling militates against radical approaches to technology design and use.

(iii) Number of decision options considered:

One specific way in which technology can be simplified is relevant to models which help to evaluate decision options. Rather than evaluating an infinite number of possibilities, a model may be applied to a 'feasible set' which can be constructed either by aggregation, or by making *a priori* judgments about which ones are likely to be chosen. Working with a feasible set allows 'silly' answers to be discarded, and speeds up the evaluation process. The disadvantages are that this requires an *a priori* judgment to be made, which may result in the discard of some valuable options. Rand (1976) considers that 'objective functions are often shallow in the regions of the optimum' - meaning that even if some good options are lost, those left will be almost as good.

(iv) Search procedure:

Another choice that is made, in the case of technological evaluation of decision options, concerns the method of searching through the options in order to make a choice. *Programming* involves the systematic evaluation of each option. *Simulation* involves a more detailed, and time-consuming, method of evaluation whereby users can explore the consequences of options by trial and error. This is a slow method of evaluation, but offers flexibility in choice of criteria. Simulation is an example of a *heuristic* approach. A heuristic is, literally, an instrument of discovery, but the term is often used by ORers to refer to a quick, approximate, computer model. Heuristics have the disadvantage that they can not *promise* accuracy, or indeed anything at all! Their

advantages are speed, and flexibility, which make them relatively good for facilitating discussion.

(v) Microcomputers:

Computing developments, primarily the introduction of microcomputers, has had a great impact upon operational research during the 1980s. The primary advantage of micros is the availability of *powerful* computation by a small machine. Consequently, extensive and accurate analysis can be carried out quickly, and relatively cheaply. Powerful computers enable model developers (such as ORers) to experiment, and adopt iterative development processes. Cheap, portable computers enable consultants to transport computer models to clients' workplaces, and facilitate wholesale model *delivery* to clients. Interactive computer modelling facilitates an iterative approach to model use (and problem-handling). Visual interactive models have the advantages of making it easy to involve clients in model use and development. They also make model development and validation easy for ORers because the internal logic of the model is clearly illustrated.

(vi) Open technology:

The term "open technology" is used by Friend and Hickling (1987) to describe technology which is "freely accessible to participants who have differing and complementary contributions to make" to problem-handling, and which can "support communications and interactions across .. boundaries". Technology which is quick, simple, customised, heuristic, visual and interactive would seem most appropriate. Under the umbrella of 'soft' OR, technology has been developed with openness in mind. Friend and Hickling's strategic choice technology, based on AIDA (analysis of interconnected decision areas - see Luckman, 1967), and Friend's subsequent development of the STRAD computer model, is an example. Eden's SODA methodology includes the use of the cognitive

mapping method, which is made to feel "the natural thing to do" (Cropper, 1984), and more recently developed group decision support systems (Ackermann and Eden, 1987).

9.3 Technology and Reality in Problem Helping

It has been said that OR's traditional use of structure has been to "impose logic upon the affairs of men" (Eden, 1989). Similarly, Rahmatian (1989) asserts that ORers "impose a mathematical structure on a given formulation in order to identify the most efficient solution". In this section, I shall attempt to articulate various different attitudes towards the relationship between OR's *technology* and the *reality* of the (problematic) situations with which they are involved. This section is closely related to the discussions in chapters 5 and 6 about the nature of problems and ORers' contributions to problem-handling. Here, I am concerned specifically with the role that technology plays in working with problems.

9.3.1 Structure, object and subject systems

Describing structured object systems

One view is that the situations facing ORers and more significantly, their clients, are structured in reality. They can, therefore, be *fully specified by the use of structure*. An ORers job is to investigate the situation, and to describe and explain the structure that is really there. Other people, (eg. problem owners) may not have been able to perceive situations correctly because they are not properly trained to comprehend the complex logic which is inherent in situations. *Structure (encapsulated in OR technology and models) acts as vessels for holding the (whole) truth. ORers must choose technology which is appropriate to the given structure of reality.* They are faced with different types of problems,

with different structures, and therefore different models are appropriate.

This view is clearly articulated by Woolley and Pidd (1980) who refer to ORers "mapping an analytical approach onto the complexity of the issues". Similarly, Bishop (1972) talks of ORers making an explicit model *of* the situation, and trying to draw clients into line with it, and Jackson and Keys (1984) appear to assume that ORers are in the business of "making models *of* situations" (emphasis added) i.e. situations which can be fully specified.

There are two main directions along which OR methodology may depart from this point:

Structuring subjective views

Rather than believing that technology provides a vessel to hold *objective reality*, it may be thought that the contents of the vessel are actually a person or group's viewpoint. This attitude is adopted by Wilson (1984), who writes that a "model is an explicit representation of one's understanding of a situation, or one's ideas about a situation". This attitude is also prevalent in soft OR.

In this view, *OR applies technology in a client-centred way.* The content of models is related to a particular subject (client) rather than directly to an object system. Also, since the structure must be appropriate for holding the content, the structure is also client-specific: *ORers must choose technology to suit a client, rather than to suit a situation in an objective sense.*

It is possible that OR's models may encapsulate certain views in a way that is not helpful: Stern (1976) and Sagasti (1976) both warn of the use of expert technology in order to impose management preferences and to obscure certain aspects of situations. Hales (see Rosenhead, 1981) describes the

consequences of OR's use of computer (and other) models as 'dead conceptual labour' - meaning that structures are applied, which encapsulate a certain management viewpoint, and thereby stifle the creativity and oppress workers' initiative.

Structuring parts of situations

In the views above, it is assumed that structure may *hold the whole of a viewpoint* - whether objective or subjective. It is also possible that ORers may try to use structure to encapsulate that *part of reality* (or a viewpoint) which is inherently structured. In other, words, the ORer is not describing the whole of reality in structure, and clients are not muddle-headed in not being able to perceive this. Rather, there is some structure deep down in a situation, and ORers are digging down to find it, removing the 'dirt, noise and confusion' in the process.

This approach is discernible in the views of the OR practitioners in this study. Chapter 5 describes the way that problems are considered to have a *structured* (mechanical, perhaps quantifiable) core. Moreover, this core is thought to exist *objectively*, and could be discerned by all social actors if they had the time, skills, inclination, and clarity of thought to do so. Lawrence (1979) warns of the dangers of assuming that a situation is fully specified within a model:

> "any computable model is completely systematised and is therefore of a lower order than the everyday logical systems within which we work freely .. it follows that any model of human thought and behaviour is bound to be crude, incomplete and naive".

Sagasti (1976) warns of using technology to 'satisfy ORers' fetishes'. This may mean simply that they like playing with computers, which is usually true, but also that they like to see situations expressed in a structured way. In this way, model use is being used to impose views of those who value the structured parts of reality, and can understand them.

Instrumental use of structure

Experience tells us that we do not have to be able to *describe all* of reality in order to be able to make some useful statement about it, to *learn* about it. Perhaps what is important is not accurate representation of reality, but *the process of achieving understanding of reality*. A model may be *instrumental* in a learning or decision process.

Such pragmatic thought has developed into more sophisticated views on the use of technology - eg Eden (1989) talks of using models "to facilitate the management of meaning". The relationship between the model (and structure) and reality, in any sense, is not considered important, as long as clients find, experientially, that models help them to understanding and learn to control reality. Nevertheless, the soft OR / systems approaches which adopt this sort of attitude tend to be those that use structure to encapsulate clients' subjective viewpoints. It should not be surprising that clients find models more useful if they encapsulate a veiwpoint with which they confer.

This attitude is also discernible in the approaches of the ORers in this study. It was epitomised by one OR practitioner who said that he aimed "to provide some insight into a problem .. *somehow or other*".

9.3.2 Structure and process

Structuring clients' problem-handling processes

It is often considered that ORers enhance decision processes with the aid of 'analytical' tools and structure, and that this often results in decision processes taking a different shape. For instance, Watson (1982) talks about decision analysis "making decision makers' methods more rational and

consistent", whilst Beer (1966) characterises OR as augmenting management by being a "scientific lobe in management's brain".

Friend and Hickling (1987) have taken the radical step of clearly distinguishing between applying structure to (i.e. 'modelling') the *content* of a decision situation and applying it to the *decision process itself*. They emphasise that the decision is the fundamental unit of analysis, and distinguish this from 'systems' approaches, which aim to study decision makers' environment. This approach is also apparent in other work such as Dando and Beresford (1978), and Gupta and Richards (1979) who are concerned with modelling decision processes rather than with modelling object systems. Such analysis can help consultants to understand the decision context better, but in some cases (such as Friend and Hickling) the aim is to inform the decision process itself.

Structuring problem-helping processes

Alternatively, ORers' application of structure could be *purely* in their process of investigation - i.e. no assumptions are made about the shape of reality re. object or subject systems, but OR makes headway with its methodical, structured, logical way of investigating situations. One ORer in this study spoke of using technology during the early stages of a project to "structure up a work-plan for yourself".

Structure can be applied to clients' processes and to OR processes simultaneously if OR work is a collaborative experience.

9.4 Summary

OR practitioners' use of technology stems from a belief that *structure is imbedded* in (problematic) situations. By *mapping* technology onto the 'structured' *parts* of situations, ORers aim to *facilitate* problem owners' understanding and control of

the *whole* of situations. ORers' use of technology can be described as *instrumental in problem helping*.

OR practitioners' use of technology spans several modes stages of problem helping. Situations (or parts of them) are *described* through a *'structured approach'* (see chapter 7), with the aid of computerised heuristics. Statistical techniques and heuristic modelling are used to *analyse* descriptions of situations. Numerical data is subjected to *computation* in order that *insightful meaning* may more easily be attributed to it.

Descriptions are assembled through a *dialogue* with clients. Similarly, analysis is conducted through an *iterative* process. ORers often use *prototype* models, with the aid of computer graphics, to *prompt* clients' response.

ORers' choice and use of technology is *contingent* upon a number of factors. These include the identity of client 'users', the nature of the decision context, and the availability of data, as well as their own competence and consulting priorities.

Chapter 10

FRAMEWORKS FOR DESCRIBING O.R. PRACTICE

In this chapter, I shall be looking at frameworks that have been used to make general statements about OR. These "general statements" vary from detailed descriptions and prescriptions of the activity to simple classification of the nature of the activity.

In the first section, I shall summarise the framework that has *emerged* through this research project. In the subsequent sections, I offer a *critical review* of frameworks that have been generated and used elsewhere within the OR community. Each of these sections necessarily begins in *descriptive* mode. However, I am concerned, not merely with describing and *reviewing* these frameworks, but with their *relevance to the subsequent development of the framework that I have developed during this research.* Specifically, for each framework, I am considering:

1. Is the framework consistent with my research findings ? i.e. is there evidence that the framework could be *valid* for describing all or part of OR practice ?;

2. Does the framework correspond to a *complete and balanced* picture of OR practice, or does it emphasise certain aspects at the expense of others ? In this case, does it emphasise the essentially *social* nature of OR practice ?;

3. Does the framework seem likely to yield a *methodology* i.e. guidance for practitioners' choice of role, ways of working, methods and techniques etc.?

10.1 The Emerging Framework

In chapter 3, I described the development of a basic framework for structuring the interviews with OR practitioners. This was a *pyramidal* framework, *relating four entities - consultant, client, problem and technology* - which had been discernible in the OR practices encountered during the pilot study. Parts of interviews focussed on each of these entities, and on *the relationships between them.* My hope was that the two-way, three-way and four-way interactions would generate insight into the nature of OR practice. This framework has been developed through, and by, the study, as I have attempted to 'frame' the interview data. The framework that has emerged has been used to undergird the description of OR practice contained in chapters 4 to 9; indeed, the 'contents' page gives some indication of how the concepts of the four entities, and their interrelationships, has developed. In this section, I shall summarise the emerging framework.

The **client** pole has been developed to incorporate:

1.1 a variety of client *role types*, which can be defined in terms of -

1.2 a variety of *types of* (or reasons for) *involvement* in OR practice (see section 4.1); and

2 a model of the social / organisational *processes* involving 'clients' (see section 4.2).

In this thesis, I have based development (1) on Bryant's 'roles around interventions, and development (2) on Radford's model of decision making. This frameworks seemed appropriate to the *anecdotal* descriptions of clients, and client processes, which were provided by ORers in this study. These developments have *not* been made as a result of careful empirical study of client processes.

The **problem** pole has undergone less rigorous development. OR approaches have often been categorised as "old and new paradigms of analysis" (Rosenhead, 1989b), or as "hard" and "soft" (eg Checkland, 1981). In contrast, the ORers' in this study had an "inclusive" (Woolley and Pidd, 1981) view of situations in general, and problems in particular. The emerging model is *onion-shaped*; problematic situations are construed to have many layers - inner layers are relatively hard, whilst outer layers are soft. Clients are construed to be potential problem owners, positioned near the outside of the 'onion', trying to develop theories and proposals *about* the onion. Problems are defined according to:

1 the position of *boundaries* between hard (objective, structured, certain etc.) layers, and soft (plural, subjective, political etc.) layers; and

2 the *location and distribution of concern and problem-defining power* amongst various 'clients' / decision participants.

Alternatively, problems may be defined in terms of their *duals* i.e. the changes in situations which would constitute *solution* (section 6.1 and 6.2).

[The nature of the **client-problem** bi-pole is absorbed into this characterisation of problems.]

The **technology** pole has been developed to describe several categories of 'expertise'. These include knowledge, skills, techniques and technology of various kinds. However, the distinctions between combinations of skills, techniques and technologies are quite blurred (see section 7.4).

The two-way interaction which is conceptually most simple is the **consultant-client** relationship. This part of the model has been elaborated to include the following:

1 *Motivations* for having consultant-client relationship
- consultants' motivations (section 8.1.1)
- clients' motivations (section 8.1.2);

2 *Nature of relationship, and how* relationship is lived out, and furthered (sections 6.3 and 8.1.3);

Both of these dimensions of relationships are compounded by consideration of the variety of client role types.

The most sophisticated development has taken place concerns the **consultant-problem** relationship i.e. the nature of (what is traditionally considered as) *problem solving*. In view of the way in which problems are defined in relation to clients, the nature of problem solving is best considered by looking at the three-way interaction, **consultant-problem-client**. I have developed two dimensions to describing problem-helping consultancy:

1 OR practitioners' *contribution* to problem solving i.e. looking at the consulting relationship *from the perspective of clients* i.e. problem owners;.

2.1 *Solution focus* - what ORers actually do / study; and

2.2 *Solution leverage* - by what mechanism / route they intend to make their contribution in (1). This second dimension constitutes a view of the consulting relationship from the consultant's point of view.

The higher-level interactions involving technology have proved quite difficult to develop, although interviewees provided much anecdotal data which has helped, here.

The **technology-consultant** bi-pole simply acknowledges ORers' varying competence and preference (see section 9.2.2).

The **technology-client** bi-pole has been developed to reflect variation of two types:

1.1 contingencies rooted in the nature of the *decision* context; and

1.2 contingencies rooted in the *identity* and preferences of clients;

[These factors simply reflect the development of the client pole, above (see section 9.2.1).]

2 choices *between* projects, and choices *within* projects (throughout section 9.2)

The **technology-problem** bi-pole, and the **technology-problem-client** interaction, have been developed by assessing:

1 relationships between technology and structure in *object and subject systems* (section 9.3.1);

2 relationships between technology and structure in intellectual and social *processes* (9.3.2).

The **technology-consultant-problem** interaction has been assessed with reference to:

1 methods of *describing* problems (section 9.1.2);

2 methods of *analysing* problems (9.1.3).

The **technology-consultant-client-problem** interaction has been considered with specific reference to:

1 methods of *inquiring* into problems (section 9.1.1);

2 methods of *presenting* ideas about problems (9.1.4);

3 methods of *negotiating solutions* to problems (9.1.5).

All of the developments above represent means of elaborating on *stances* which are adopted in OR practice. This is an essentially *static* view of OR. However, I began by referring to client *processes*, and have then referred to *relationships* of various kinds. The dimension of *time* represents a significant development of the framework. Indeed, many of the most interesting findings of this research are underemphasised if the *dynamics* of OR practice are overlooked.

The ways in which the element of time affects the pyramidal model are as follows: **Clients** are engaged in *ongoing processes* of decision making and issue handling (sections 4.2.4 and 6.1). **Consultants and clients** are engaged in ongoing relationships. Specifically, consultants are engaged in ongoing processes in relation to clients' **problems**. Consultants' contributions and activities may transcend individual projects (sections 6.4.4 and 8.5-8.7). Consultants' choice and use of **technology** are also heavily influenced by long-term considerations (throughout section 9.2).

Alternative frameworks for OR will now be considered, beginning with the notion of 'science' as a way of describing the nature and method of OR.

10.2 Science

Operational research has been associated with science since it began to be recognised as a practice *per se*, during the second world war (see chapter 1). The earliest ORers were scientists, drawn from a variety of scientific disciplines, and their contribution to the war effort was publicised in "Science at war" (Crowther and Whiddington, 1947). However, Dando and Sharp (1978) have remarked that the fact that ORers were former scientists does not imply that their new activity was scientific, or science *per se*. The idea that OR might be

scientific, or that it might be *a* science, or even science itself, was encouraged by Goodeve (1952), Morse (1956), and Ackoff (1956). Science then became a dominant theme in the earliest OR textbooks - notably Churchman, Ackoff and Arnoff (1957), Ackoff (1962) and Beer (1966). For many years, the OR Society used a definition of OR which included several references to science.

More recent debate has led to the suggestion (or assumption) that OR might be a *technological* activity, rather than a scientific one (see Dando, Defrenne and Sharp, 1977, Raitt, 1978 and 1979, Ravn, 1977, and Keys, 1989b and 1991b). Clearly, the debate hinges on what is meant by "science" (and "scientific") and "technology". There are two approaches here: OR could be considered to be a 'scientific' activity if it embodies many or all of the characteristic features of science (similarly for technology). Alternatively, it could be considered scientific if, and only if, OR practitioners use a particular *method*, as used in science. I shall begin by considering the first, broader, association with science, in terms of the concepts of fact, rigour, knowledge, and objectivity, because these concepts seem to represent the 'spirit' of science.

Science is popularly thought to be about 'facts' - as opposed to myth, make-believe etc. Although this view of science can be criticised (see chapter 2), it is clear that, in this sense, OR is quite 'scientific'. All the in-house OR workers in this study are concerned with directly addressing an 'object' system, to find out 'what's really happening' (chapter 6). However, this empirical basis for OR has been challenged by the proponents of soft OR (Eden and Sims, 1979, Friend and Hickling, 1987, for instance), and practitioners are increasingly concerned with clients' perceptions, or constructions, of the world.

Science also has associations with rigour, careful scrutiny, and comprehensive analysis. OR practitioners in this study

spoke of their 'structured approach', and of 'building up the whole picture'. In this sense, also, OR practice seems to be 'scientific'. However, OR has sometimes been associated with science in ways which are inconsistent with this theme of rigour and completeness: Waddington (1973) suggests that OR 'scientists' might focus on "certain important [variables] which are particularly suitable for quantitative treatment, and .. ignore the rest". The tendency for ORers to address "part problems" - i.e. including only those aspects of situations which are readily quantifiable - is also evident from my study (see chapters 5, and 6).

The development of knowledge, encapsulated in theories, is characteristic of science. I have described ORers' contributions to management processes as including 'imparting understanding' and 'reducing uncertainty' about clients' environments (chapter 6). I have said that they 'have a hope of discovering the truth about reality' (see also chapter 2). They are investigators, who build on existing 'background knowledge' (chs. 6, 7). I have described how such project-based contributions form parts of a broader, relationship-based, contribution (ch. 8). There is some evidence, then, that OR practitioners are concerned with building a *local (social) science* - a body of knowledge about their clients' environment. However, the ultimate aim of ORers is not to develop knowledge, but to effect or facilitate decision-making. Further, the important thing in OR is that *clients'* pool of knowledge develops, not ORers'; providing this continues to happen, OR consultants do not actually need to possess the knowledge themselves.

Undoubtedly, one of the attractions, for OR, in its association with science, lies in its claim to objectivity. I have discussed the 'objective' nature of science in chapter 2. Ackoff (1974) has made taken up the argument with respect to OR:

> "to conceive of objectivity in terms of thoughtless observations made by man emulating a camera or a tape-recorder, is to conceive of the scientist as a

> machine, not a man. The scientist can no more be a machine than a machine can be a man. .. Objectivity is not the absence of values in purposeful behaviour, simply because purposeful behaviour cannot be value-free. Objectivity is .. a systemic property of science taken as a whole, not a property of the individual scientist. There is no concept as value-loaded a objectivity itself".

Bevan (1976) argues that the OR world does not have the level of criticism which would allow it to be called a 'scientific' community. Indeed, if OR's science is a *local* one, the opportunities for criticism, and therefore 'objectification', are limited. It seems that OR cannot achieve the 'objectivity' of science. However, objectivity is a vital part of OR's *image* (Mitchell, 1980). In reality, this is general *trustworthiness*, and an unspoken commitment to a particular *subjective* viewpoint - that of the problem owner, and an attempt to avoid "the 'you're on their side' hang-up" (Williams, 1983, see chapter 8).

It seems that OR has some similar characteristics of science, particularly where rigour and facts are concerned. We could now consider, in greater detail, whether or not OR practitioners use a *method* that is characteristic of 'science'. However, there is no universal agreement about what constitutes 'scientific method'. For instance, writers such as Waddington (1973) assumed OR's approach to be inductive, but this is widely discredited as a description (or prescription) of the nature of scientific method. However, this does *not* imply that OR is not scientific (Keys, 1989b); nor does it imply that OR practitioners do not use inductive method. It simply makes it very difficult to attempt to characterise OR as science (or not) by appeal to a particular method.

In summary, it can be said that OR is within the "broad scientific tradition" (Cook, 1978). Dando and Bennett (1981) argued that

> "ideas in the philosophy of science do have a significant effect on OR .., albeit more by a process of 'intellectual osmosis' than by any conscious deliberation .. Though OR has no specific empirical

> paradigm of its own, it does have what we might call a 'methodological' paradigm, .. it has a commitment to 'the scientific method'".

OR has a *cultural association* with science. It may also be true that OR work is similar to *what scientists actually do* (Cook, 1978, Rivett, 1989), although it has so far proved difficult to demonstrate commonality or difference in method.

10.2.1 Technology

The difficulties encountered in trying to describe OR as a scientific activity has led a number of authors to suggest that OR might actually be a technological activity, *instead*. Malin (1981) has suggested that OR's methods have more in common with the heuristic methods associated with technological development; White (1970) has suggested that ORers might be call "decision technologists". My descriptions, in chapters 6 and 9, of OR practitioners seeking to *effect* insight and decisions through pragmatic application of structure, lend support to this view. However, the concept of OR as technology (or as a technological activity) is poorly developed. Authors such as Ravn (1977), Dando et al. (1977) and Keys (1989b) have argued *from* the 'OR is technological' point of view, but have not argued *to* it.

Ideas about the relationship between science and technology are important here. Barnes and Edge (1982) are concerned with "science purely and simply as a phenomena; that is, with activities generally accepted and described as scientific". They discuss technology in the same way. They go on to suggest a symmetrical relationship, whereby both science and technology are "distinguishable subcultures each with their own bodies of lore and competence". However, Mayr (1982) argues that the problem of distinguishing between science and technology "is an illusion created by the attempt to give precise and rigorous definition to terms that in ordinary language are used only

loosely". He describes 'science and technology' as a *single entity, with two accents*.

The argument about whether OR is scientific or technological may, therefore, be a red herring. It is clear that 'science and technology', together, communicate many characteristic features of OR practice and culture. They offer OR practitioners *a* useful myth, and a vast field of work from which they can learn, although this myth may not reflect a *balanced* picture of the nature of OR. Most notably, the 'science and/or technology' myth does not adequately reflect the *social* nature of OR practice. Moreover, the use of any characteristic methods or technology is not emphasised by this myth. This latter omission is surprising in view of OR's claim to 'scientific *method*. Keys (1991b) points to Feyerabend (1975), who argues that there *is* no method which is characteristic of science. This may explain why attempts to derive an OR method from the myth of science have not been particularly fruitful. Nevertheless, the most popular framework for describing OR practice is derived from a notion of scientific method. This framework, the 'process of OR', will be discussed in the following section.

10.2.2 The process of OR

Conway (1984) describes the history of the concept of 'the OR process', and its influence through OR textbooks. Churchman, Ackoff and Arnoff (1957) set the pattern by describing OR in terms of the following stages:

1. Formulating the problem
2. Constructing a mathematical model
3. Deriving a solution
4. Testing the model and its solution
5. Establishing controls over the solution
6. Putting the solution to work - implementation.

There has been much criticism of this stepwise type of representation of OR. The most serious criticism is that there has been "a complete absence of any formal comparisons between this generally accepted model and actual practice" (Conway, 1984). Conway's other criticisms are that: it is difficult to identify clearly delineated chronological steps within an OR project; the sequence of activities omits reference to methodological decisions made by practitioners; the sequence omits reference to interactions between projects. The second of these criticisms has received some attention from White (1975), whilst Conway's address of the third criticism is described in chapter 8 of this thesis.

Two major questions to be addressed concerning the OR process are as follows: can OR be described as a sequence of activities? ; if so, what activities are these? Such a sequence of activities must describe the *whole* of the OR process. My chosen research methods have not included longitudinal studies of practitioners' work. However, I have argued, in chapter 8, that OR is better viewed as a relationship-based (rather than project-based) practice, so it is not clear where a descriptive sequence should start and finish, or how the validity of such a sequence could be tested.

OR practitioners in this study had the opportunity, during second interviews, to describe the 'typical' development of a project. Only one practitioner found this a comfortable experience. Even in this case, the identification of distinct activities, or a regular sequence of events, was swamped by contingencies. *Consequently, I have chosen not to attempt to analyse this data in terms of an 'OR process'.* It is quite possible that further analysis might yield a sequence of events plus some methodological guidance. However, this seems unlikely: where I *have* decomposed OR process into (four) 'stages' - inquiry, description, analysis and presentation - in chapter 6, my findings show considerable interdependence between the stages.

Even if it proved possible to identify an OR process, this might not necessarily be a *useful* thing to do. The implication of this type of model is that the practitioner's aim is to get to the bottom of the list. Eden (1987) considers this attitude to be typical of western culture and education, but to be inappropriate to client-centred consultancy. Not only do the 'process' descriptions of OR generally make no reference to clients, as human beings, but they do not mention OR practitioners either. Instead the roles of the main characters appear as de-humanised activities, as subject-free verbs which are conveniently expressed as imperatives or present participles.

Process frameworks simply do not reflect the human and social nature of OR practice. Neither do they reflect the fact that OR workers have a repertoire of techniques and technology which have a high profile. Several authors have attempted to make adjustments to the 'process' model. Mathew (1957) added, to the process, the tools that are used within the process, and the team (of clients and ORers) who participate in the process. Many authors, such as Sagasti and Mitroff (1973), Bonder (1973), Bowen (1977), and Muller Merbach (1982) have argued that OR should be viewed as a totality - a system - and the various activities as parts of this system, rather than as chronological stages.

The work of Steen Hildebrandt is significant here. Hildebrandt (1977) begins by asserting that OR adopts (or should adopt) an "interactionist strategy" whereby OR influences clients through a on-going process of change, rather than through the results of a period of "expert" analysis. Hildebrandt's model of OR practice incorporates four different perspectives. One of these perspectives is a "phases" model of OR process, although Hildebrandt adopts the 'systems' view here, and argues that the component activities can only be understood in relation to the other components. To this, he adds an "interest groups" (managers, analysts and other stakeholders) perspective, and a "strategies" perspective, which considers the repertoire of

problem helping roles from which an ORer may choose. Finally, there are the constraints and variables (such as personality and organisational characteristics) which impinge upon OR practice.

Hildebrandt's model provides a more balanced view of OR practice. It is interesting to note that the 'interest groups' and 'strategies' perspectives are reflected in my research - see chapters 4 and 8, and 6 and 9, respectively. However, Hildebrandt's model does not *integrate* these perspectives within a total view of OR which could yield methodologies for dealing with clients, problems and technology.

Before completing this discussion of 'OR process' models, it is helpful to look at the research of Woolley and Pidd into *problem structuring* and *implementation*, which are two components of the typical process model. Woolley and Pidd's (1981) literature study revealed four streams of though about the nature of problem structuring in OR:

Checklist - a tightly specified procedure through which the location and nature of a problem is articulated; a similar approach to that used for examining a faulty car engine;

Definition - problem structuring involves specifying the basic elements of a typical 'rational' decision process, namely options, consequences, objectives etc.

Science/Research - problem structuring involves rigorous study to discover the causes and effects in an 'objective' problem situation;

People - problems are regarded as social constructs, so problem-structuring involves focusing on the way people define problems, and negotiate them through social processes.

Whilst Woolley and Pidd recognised valuable features in all these approaches, their experience and study of OR *practice*

suggested that problems are structured through an *"exploration"* approach, which has the following facets:

informality - there is no formal procedure, just an informal process of questioning and discussion;

hierarchy - some OR projects spawn others of a relatively technical nature;

continuance - problem structuring is not a once-for-all activity, but continues, in some sense, throughout a project;

inclusiveness - problems include both objective and subjective elements.

The same "exploration" approach is thought to be relevant to implementation (Pidd, 1988). Moreover, each of the streams of thought seem to correspond to a particular view of OR *as a whole* (see Pidd, 1988). Indeed, some facets of the exploration approach seem to militate against the stepwise framework in which the activities of problem structuring and implementation are set: "Informality" and "continuance" suggest that clear delineation of an OR method may be inappropriate. "Hierarchy" suggests that the activities within different OR projects may themselves differ, whilst "continuance" suggests that OR's problem-helping contribution may not be made in a strictly project-by-project way. It is clear that the notion of 'exploration' is a useful tool for describing the nature of OR.

The various facets of the exploration approach are consistent with themes in my research: "Inclusiveness" is relevant to the nature of problem in OR practice (see chapter 5). "Hierarchy" and "continuance" are relevant to the relationship-based view of OR in chapters 6 and 8. "Informality" is relevant to the nature of OR's technology and "structured approach", and their use in problem solving (chapters 7 and 9). However, "exploration" does not describe what OR is actually *about* -

what OR practitioners *do*. It can only 'flesh out' a framework which specifies these fundamentals. I have suggested, in this section, that exploration fits more comfortably within my pyramidal model of OR as a problem-helping consultancy than it fit with the classical model of OR process.

10.3 Scholz's Conceptual Framework

Christian Scholz has made a laudable attempt to devise a framework to underpin methodological development in OR. Scholz (1984) remarks that "the term 'methodology' has gained such an inclusive connotation that it comes to denote nothing in particular". Scholz uses the term to mean something quite specific: "a 'science of dealing with methods', which evaluates methods and gives information such as how to construct algorithms or how to use specific kinds of models".

There are seven components to the framework which Scholz uses to describe OR methodology. Three of these components are concerned with "algorithmic aspects", and address the following issues: how to create 'new' methods, how to get 'correct' models, and how to get 'acceptable' methods. Three components are concerned with "behavioural aspects", and address the following issues: how to understand the client system, how to understand the research system, and how to design the 'right' interaction process [i.e. interaction between researchers and clients]. The seventh component is concerned with how to compose a suitable OR process which integrates algorithmic and behavioural aspects.

Scholz is not content with making generalisations about the nature of OR work, but is concerned with the ways in which OR practitioners, and the OR community as a whole, choose approaches to each of these seven areas. For instance, he suggests that the development of acceptable methods may be done either by an *a priori* approach, whereby methods are selected according to some given specification of what types of methods

are likely to be acceptable, or by an *empirical* approach, whereby ORers study the individual factors which determine the acceptability of methods. (Both approaches involve fieldwork, but their starting points are different.) The same two approaches may be used to choose an interaction process.

Scholz does not actually suggest which a priori criteria, or which factors, should be used. Instead, he gives examples of work in each of these areas. For instance, Churchman and Schainblatt (1965) and Eden and Sims (1979) are cited as examples of *a priori* approaches to client relations, whilst Ackoff's collection of "unsuccessful case studies" (Ackoff, 1960) is an example of an *empirical* approach.

Scholz's analysis refers to three 'points' of the pyramidal model; it does not mention problems or problem-solving, as such. His work points to ways in which ORers may develop or select preferred ways of working from basic principles concerning the nature, and relationships between, consultants, clients and technology. Similar approaches could be adopted for the other three edges and three faces of the pyramid. The ways of working described in chapters 4 to 9 of this thesis are part of an empirical approach to methodological development.

I have two criticisms of Scholz's approach. Firstly, it is essentially reductionist. His paper suggests that models can be developed, and consulting stances can be adopted, without explicit reference to the overall nature and aim of OR. This 'building blocks' sort of approach is useful for *describing* OR - indeed, I have used this approach in this research - but it is inappropriate for methodological development. In terms of the pyramid, approaches to each face of the pyramid must be guided by an overall strategy given by the nature of the solid structure; choices about each edge must be guided by notions about the shape of the face etc.

This does not necessarily always happen in practice. ORers may be using 'old-fashioned' techniques and consulting stances

which were designed with reference to notions of operational research which are now defunct. Indeed, it was a feeling that this was probably the case which led to a series of critical analyses of OR during the late 1970s and 1980s, notably by Ackoff (1979a,b) who threw "the OR Society .. into apoplexy .. by declaring that OR was dead and then trying to resurrect it" (Martin, 1984). My second criticism of Scholz is that his commentary on his seventh component of OR methodology, i.e. how to integrate methods and people into an overall OR process, is too conservative. He assumes that this component "deals with the OR/MS process along a time axis (problem formulation to system maintenance)" (Scholz, 1984). It is important that visionary work, such as that by Eden and Sims (1979), Friend and Jessop (1969), Boothroyd (1978) and Checkland (1981) are allowed to influence ORers' thinking, and to prod them into (re-)considering what OR is all about, and how it should be described.

10.4 Friend and Hickling's A-TOPP Framework

Friend and Hickling (1987) describe their "Strategic Choice" approach with reference to a framework that they call A-TOPP, which stands for approach, technology, organisation, process and product. Coincidentally, they also use the shape of a pyramid to provide a simple, yet powerful, framework for describing the nature of their approach:

> "The solid structure of the tetrahedron itself is intended to represent the idea of an overall approach viewed in a relatively complete, multi-dimensional way. The picture as a whole is intended to convey the message that each aspect of the approach can be selected in turn as the focus of attention - yet none of them can ever be viewed entirely in isolation from the other three". (Friend and Hickling, 1987)

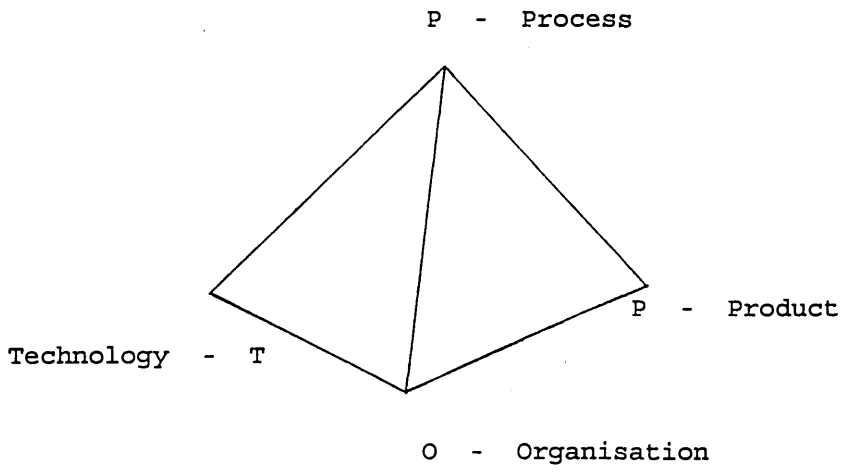


Figure 10

In addition to this tetrahedron, Friend and Hickling (1987) employ a notion of 'problems' in terms of uncertainty pertaining to values, to the decision-making environment, and to related decisions (see chapter 5). To complete a framework for describing one OR approach, their overall "approach" is defined to be directed towards *effectiveness* rather than optimality in decision processes. This particular view of problems leads to *particular* policies towards technology, organisation etc., but the basic components of A-TOPP seem to be relevant to describing OR in general. We have seen that "technology" and "process" have been used in describing OR; "organisation" is concerned with the social context of OR work, and with the way people are interrelated in the problem-solving process (consultancy issues could be covered here); "product" is concerned with the aims of OR work, and with the ways in which the problem-helping experience is evaluated.

Friend and Hickling's model has a number of attractive features. The first of these is that it is *holistic* in nature, unlike Scholz's. By this, I mean that the four aspects of the approach that are represented in the points of the tetrahedron are integral parts of a total approach. The strategic choice

approach is described in terms of basic *"orientations"* with respect to these four aspects of the work: These are to employ *open* technology, within a *learning* process, to make *incremental* progress, with *interactive* participants (clients). Thus the description of the approach, in terms of four components, proceeds from an overall statement about its nature.

Secondly, each of these "orientations" forms the basis of a particular area of *comprehensive* methodological development. From the "orientations", *"operational guidelines"* are developed; it is at this level that the *characteristic* nature of the approach becomes evident. Then, associated with each operational guideline, is a set of *choices* to be made about *management of the decision-aiding process*, and about the *workaday practicalities*. Finally, each orientation suggests a particular *"evaluation emphasis"*.

It is best to illustrate the model by example: The basic orientation with regard to organisation is that decision-making is an interactive social process. This is translated into an operational guideline which says that lateral connections between various people and groups should be stressed, and should be used to reduce uncertainty: UV can be reduced through policy guidance and the inclusion of various interest group; UE can be reduced through consultancy and data collection; UR can be reduced through interaction with other decision makers. The consultant is faced with choices about the management of interaction processes - such as how and when to encourage particular relationships, and how to structure the consultancy intervention. He/she also has to make choices about the practicalities of working with groups - such as who is (or should be) the group leader, who will facilitate and record progress etc. Progress is assessed by considering the synergy of various decision-making contributions, rather than the efficiency with which outcomes are established.

Friend and Hickling's model can contribute to my pyramidal model, and to attempts to develop OR methodology with respect

to it. Firstly, it may be possible to 'rationalise' ideas, about (eg) clients or technology or the relationship between them, into 'orientations' and 'operational guidelines', such that relevant methodological options and choices can be articulated. This would be an example of an *a priori* approach to OR methodology (Scholz, 1984). Secondly, Friend and Hickling's attention to the *dynamic* aspects of *process* and *product* points to areas in which my research has not been fully developed. Consequently, I have described OR in an essentially *static* way. The main problem here has been that in order to describe OR, from empirical study, *longitudinal* methods are necessary in order to properly elicit the *dynamic* aspects of the practice.

10.5 OR as Articulate Intervention

Hylton Boothroyd's notion of OR as "Articulate Intervention" (Boothroyd, 1978) has become a standard reference in writings on OR methodology. The basis of Boothroyd's language is the concept of "action programme" which consists of actions (behaviour and its consequences), theories and proposals. The word "programme" is used to suggest "a continuing process which has associations with the perceptions and intentions of human actors and which also has associations of stability and adjustability as it progress". "Theory" refers to things like opinions, facts and measurements, as well as formal, 'scientific' theories. Both 'theory' and 'programme' have associations with Popper's and Lakatos' descriptions of scientific development. "Proposal" refers to goals and policies, and to "ideas of what constitutes good and best" (Boothroyd, 1978). An action programme may correspond to an individual, or to a group or organisation, in which cases the component individuals are continually involved in rehearsing and redefining the meaning of the programme.

Operational research is characterised as articulate intervention of one action programme into another - as "the

practice of intervening in action programmes to provide articulate reflection on action proposals .." The intervention practice of OR is, itself, viewed as an action programme. Here, OR practitioners join clients in articulating (through speech, writings, diagrams, maths, computer displays etc.) theories and proposals - and imagined actions and their consequences - for deliberating action (Boothroyd, 1988). OR practitioners may also participate in deliberation, and may elaborate and improve the means of articulation and deliberation.

Despite becoming a standard reference, Boothroyd's ideas do not seem to have been used or developed by other OR people. Pidd (1985) comments that Boothroyd is describing the *nature* of OR, but not the *practice*, whilst Conway (1984) considers Boothroyd's work as unsuitable as a basis for developing a (stepwise) methodology. The level of generality, precise language and intellectual content of Boothroyd's work make his ideas and framework largely inaccessible. It seems that only Boothroyd would be able to translate his description of OR's nature into actionable guidance. I am fortunate enough to have been a student on one of Boothroyd's undergraduate courses, and have undoubtedly been influenced by him.

It has been suggested (Pidd, 1989) that there are similarities between Boothroyd's model and mine. Some of the terminology is certainly similar. I have borrowed the notions of 'theories' and 'proposals' in describing the context of OR work, i.e. the client world in which OR intervenes (see chapter 4). I have used something like the distinction been 'articulating proposals' and 'deliberating action' to emphasise the roles of individual managers in social decision-making processes. I have described OR work as aiding clients in the formulation of theories and proposals, by the adoption of a structured approach, and with the aid of explicit models.

The notion of an *joint* action programme is, however, quite foreign to my thinking. I have focussed on *individuals*, such

as OR practitioners, problem-owners, sponsors etc. I have deliberately chosen to describe OR in terms of the work and lives of OR practitioners, rather than in terms of OR *groups* and other departments and organisations, or to describe the concept of OR in some broader, vaguer, sense. Whilst action programmes consist of human artefacts such as actions, theories and proposals, they do not necessarily correspond to individual people. It therefore seems unlikely that Boothroyd's notion of articulate intervention will yield a methodology which fully reflects the human and interpersonal aspects of OR.

Furthermore, despite references to "realisations of abstract technology", Boothroyd's language does not seem to reflect the prevalent workaday *technical* realities of computers, spreadsheets and simulation models. Boothroyd has, more recently, addressed OR's 'technology' (Boothroyd, 1988), suggesting that ORers' 'structured approach' may operate at various level:

A improvisation;
B following a collection of hints and tips;
C by systematic methods, to
    (i) provide a framework,
    (ii) prompt insight and improvisation;
D by programmed methods.

ORers may be involved in a variety of activities, such as:

1. analysis of fundamental business decisions;
2. measurement and data acquisition;
3. information management;
4. devising decision/negotiation support tools;
5. brokerage in decision/negotiation support tools;
6. acting as managers of client processes.

OR can therefore be *described* using a two-way grid. For instance, the work of the ORers in this study could be shown, approximately, as follows:

	A	B	C (i)	(ii)	D
1. fundamentals		**********			
2. measure and data				*********	
3. information					***
4. devising DNS			**********		
5. DNS brokerage	**********				
6. managers					

This descriptive framework is similar to the analysis of applications of technology and expertise, in chapter 9. It demonstrates that OR has a broad repertoire of activities and methods, but does not suggest either a methodological *paradigm*, or any practical guidance.

10.6 OR as Organisational Actor

In this section, I shall comment on two recent, but quite different approaches to describing OR. One approach is that of Keys (1991a) whereby various metaphors for 'organisation' are used to "suggest" things about OR's role in organisations. The second approach is that of Bryant (1989) who uses one particular metaphor, that of organisational life as drama, to discuss the nature of problems and problem-solving.

Keys' work is based on Morgan's (1986) summary of various metaphors for talking about organisations. By looking at OR "from an organisation's viewpoint", Keys aims at a "wider vision of OR as part of an organisation" than is achieved by looking through the eyes of an individual practitioner. Consequently, Keys' analysis might be insightful, and might have implications for those with overall responsibility for the use of OR within an organisation (eg OR managers, and those to whom OR managers are accountable). However, unless a metaphor

distinguishes individual OR workers, they are unlikely to be able to derive much direct guidance from the analysis.

Keys' uses deductive reasoning to derive an understanding of OR's role from a particular view of organisation. The 'meta-paradigm' within which this process occurs is undeclared, but Keys appears to treat OR as being broadly concerned with improving organisational 'performance', particularly through information management.

The metaphors used are organisations as: machines; organisms; brains; cultures; political systems; psychic prisons; flux and transformation; and instruments of domination. Those which seem most relevant to the *views of ORers* interviewed in this research are *machines* (by which organisations are regarded as inanimate objects) - see chapter 5, on the nature of problems - and *culture* (emphasis is on the meanings attributed by individuals within an organisation) - see chapter 5, on problems, and chapter 8, on relationships.

Clearly, the metaphor of *culture* is most relevant to my research priorities. The role of *mythos* in organisations is emphasised. Keys takes the myth of science to be relevant to OR: "signals of rigour, objectivity, empiricism and scientism are attached to OR and members of an OR group are expected to behave in accordance with this set of values and beliefs" (Keys, 1991a). This is consistent with my comments in the above section on science. Other myths which can be discerned in OR practice include those of 'expert consultancy', and 'problem helper and friend'. These myths are helpful for describing the nature of OR, but it is not obvious how a diverse (and perhaps contradictory) set of myths can be translated in methodological guidance for practitioners.

Bryant's (1989) approach to describing problems, problem solving, and problem-helping consultancy, utilises the metaphor of 'organisation as drama'. This metaphor is attractive because of its accuracy. As Mangham (1978) puts it, "the

proper analogy for man is man". Insight into the nature of organisational life will also be directly *actionable* -its will be expressed in terms of stages, scenes, roles, scripts, props etc., to which an actor in dramatic presentation can directly relate.

Bryant comments on the use of pseudo-scientific problem-helping. However, he is not concerned with the organisational role of OR, but with the kind of help that a problem owner might receive from consultants of this genre. If this approach was developed further, the insight it could provide to OR practitioners would be a client-centred view of the process and products of problem helping. OR's characteristic methods and technology would, presumably, feature as 'props' in the organisational drama. Alternatively, "technology" and "problem" could take on a life of their own, being cast as 'actors' in the play.

10.7 Methodological Paradigms

During the early 1980s, debate within the OR and 'Systems' communities centred around characterisations of these approaches which utilised the notions of sociological, philosophical or methodological 'paradigms'. Much debate was descriptive and polemic in nature, although some authors were striving to develop OR/systems methodologies. It is therefore worth considering how these descriptive paradigms fit with 'normative' OR as described in this thesis, and what implications they may have for methodological development.

Sociological and Metaphysical Paradigms

Dando and Bennett (1981) offered three sociological paradigms that could be used to characterise OR. These were: (a) positivist sociology, leading to an "official" approach to social study and to OR, whereby a client manager's viewpoint is assumed to be *the* objective viewpoint; (b) interpretive

sociology, leading to a "reformist" approach, whereby pluralism and communication between social actors are emphasised; (c) critical sociology, leading to a "revolutionary" approach, whereby structural change and conflict are examined. Rosenhead (1989c) later suggested that 'reformist' approaches do not actually challenge the *status quo*, and are therefore essentially "control" paradigms (see also Vidal, 1989).

Gault (1982) suggested that *metaphysical* paradigms lie at the root of the various different approaches. For instance, a reformist approach may be based on humanist beliefs, or on religious beliefs in a 'natural telos' (eg New Age); a revolutionary approach may be based on various utopian ideologies, including Christian beliefs, as well as on Marxism. Similarly, Rivett (1983) remarks that "it all comes down to the view of the world that you have .." Checkland (1983) traces functional/positivist sociology to a 'hard' view of reality as "systemic", and interpretive sociology to a 'soft' view of reality as "problematic".

In chapter 5, I described a number of dualisms (eg subject/object, technical/human) which seem to underlie OR practitioners' views of problems. It seemed that problems in OR could be described as being 'onion'-shaped, having many concentric layers. The innermost layers are hard, technical and objective, whilst the outer layers are softer, subjective and human. ORers perceive situations as 'inclusive' (Woolley and Pidd, 1981).

This view of situations does not fit one particular typical sociological paradigm, as described above. *Instead, parts of situations are considered to be suitable for positivist/functional analysis; other parts are better suited to interpretive methods.* ORers might wish to draw upon a wide range of material from natural and social sciences. They would seek to apply 'results' from different disciplines (and from within different paradigms) to different *areas* of their work. ORers' beliefs do not seem to be easily associated with a

particular metaphysical paradigm - a label like 'realist/humanist' might, perhaps, convey some truth.

Methodological Paradigms

Checkland (1983) claims that the 'hard' (positivist/functionalist) paradigm implies the use of a *systematic* approach to study. In contrast, he adopts a 'soft' (interpretive) perspective, and a "*systemic*" methodology, which "transfers the notion of systemicity form the world to the process of enquiry into the world". He does not, however, explain *why* a systemic (or even systematic) methodology should be appropriate to a reality that is essentially *problematic* (see also Checkland, 1985). Rychetnik (1984) takes up this point - "structural qualities of language indicate something about the structure of reality itself, since language incorporates and concentrates thousands of years of social experience of humans dealing with reality".

The approach of the OR practitioners in this research displays greater internal consistency, here. A 'structured approach' is appropriate primarily because *part* of reality is thought to be "structured in reality" (see chapter 9). This "part" of reality includes the technical/objective layers, but also some behavioural issues which are subject to debate, but are still ultimately structured in nature. However, ORers also made a more cautious claim to the appropriateness of structure for 'purely' instrumental purposes - i.e. for stimulating decision-making processes, framing debate, inquiry etc (chapter 9). This betrays a belief in the reality of *order* in a broader sense. Rivett's (1981) comment, about the need for ORers to "*discern* structure through the fog of ambiguity" (emphasis added) is suitably ambiguous, here.

Significant methodological dilemmas facing OR practitioners within the 'onion' paradigm concern the points at which situations are thought to be sufficiently soft to require the inclusion of dialectic (and politic) into method. Despite

ORers' 'inclusive' perspective, it is possible for them to define hard/soft boundaries in such a way that social and ethical considerations are included or excluded at the whim of the consultant. If such boundaries are part of OR methodology, then it is important that their position should be constantly open to question, through teamwork, professional education and criticism, and other forms of social involvement.

10.8 Summary

The concepts of scientific approach, technology, exploration and articulate intervention are all useful for describing aspects of OR practice and methodology: *'Science'* is relevant to ORers' rigorous approach, and to their concern with empirical data; *'Technology'* is relevant to their pragmatic approach to problem helping, and to their use of technology, in the narrower sense; *'Exploration'* is relevant to ORers' views of problems, with their hard and soft aspects; *'Articulate intervention'* is relevant to the decision context of OR, and to ORers' contribution to this.

None of these concepts seem to give due emphasis, either to the *social / interpersonal* basis of OR practice, or to the use of the *technology* which characterises ORers' approach.

None of these concepts look likely to *yield methodological guidance* for actually practicing OR. The *'A-TOPP'* framework looks most promising in this respect, as it explicitly encourages the development of *operational guidelines* from basic *orientations*. In particular, the notions of "process" and "product" may be useful in the development of my pyramidal framework, as they address the *dynamics* of problem handling, and the *contributions* which ORers make to clients' processes.

Scholz's framework also explicitly addresses methodological development, although the framework does not put appropriate emphasis on the centrality of *problems* in OR practice and

methodology. In Scholz's terminology, my research is part of an *empirical* approach to deriving ORers' "orientations".

Chapter 11

Professional Effectiveness and Education in Operational Research

The original proposal for this research referred to consideration of the meaning of 'effectiveness' in OR practice, and the formulation of guidelines for effective practice. This chapter begins with a discussion of different approaches to evaluating the effectiveness of OR. It will be shown that there are many ways try to assess OR, and that all of these pose significant methodological problems.

From an early stage in this research project, the concept of *"professional effectiveness"* as described by Argyris and Schon (1974) was very influential. This chapter continues with a summary of their ideas, and goes on to explain how they apply to the development of effectiveness in OR practice; this involves the development of *educational programmes*. An attempt to develop part of a postgraduate OR course is described, and conclusions are drawn about the implications that this research project has for OR education.

11.1 Methods of Evaluating Operational Research

There are a number of different approaches that could be used to assess the value, or effectiveness, of operational research. Many of these approaches examine the relationship between OR and something else - such as a client organisation - in order to assess what *impact* OR is having on its environment. I shall consider this type of evaluation approach first, and then consider alternatives.

11.1.1 Assessing the impact of OR

These methods of evaluation can be further sub-divided into four categories, namely methods which assess OR *by project, by practitioner, by group, or by discipline.* Each of these types of method has been used, or alluded to, by the OR practitioners in this research; similarly, each type of method has previously been used in discussions within the OR community, and most have been published in literature such as the Journal of the OR Society.

Several times in this thesis, it has been noted that OR has often been described on a 'project' basis, and is usually administered in this sort of way. It is therefore not surprising that many people have attempted to measure the 'success' or 'effectiveness' of OR by considering the outcomes of individual OR projects. Work by Wedley and Ferrie (1978) is a good example of work in this area.

Wedley and Ferrie define a project to be "successful" if it yields recommendations for changes to be made in the operations of the client organisation. A project is deemed to be "implemented" if any of these recommended changes are actually acted upon by client managers. These definitions have an obvious appeal as attempts to characterise the way in which OR is 'supposed' to influence its environment. There are, however, a number of deficiencies in this type of method: In Wedley and Ferrie's research, a sample of OR analysts judged 41 out of 49 projects to be successful, and 31 of these to have been implemented; a corresponding sample of client managers judged 38 of the same 49 projects to be successful, but only 10 of these to have been implemented. This discrepancy shows that different people can make vastly different assessments of a project's outcome, particularly concerning its influence in clients' decision-making processes. Sorensen and Zand (1975) developed a measure of "success" which combined a number of 'objective' and 'subjective' factors. These factors were "implementation"

(meaning clients' use of an OR-developed computer model), profitability, practitioner satisfaction, and client satisfaction. [OR practitioners in this research indicated that problem owners' response to a project's outcome is a significant factor in *their* evaluation of project work.]

Another problem is brought to light by the realisation that project assessment is a subjective process: It might be reasonably easy to develop a convention whereby either practitioners or sponsors make assessments of projects, but it has been shown (chapters 4 and 8) that several other social actors have roles to play in OR projects. Any choice of a method for evaluating OR depends upon an *a priori* judgment about which of these actors are considered to be 'significant', and 'real' *customers* of OR,

There are two, more fundamental, problems with 'project' methods of evaluation, which concern one of the main tenets of this thesis: namely that operational researchers make their contribution to clients' organisations by means of an ongoing relationship in which a number of (often inter-related) projects are embedded. Firstly, it is not, therefore, appropriate to assess the impact of individual OR projects as if they were conducted 'in a vacuum'. Secondly, as Bevan and Bryer (1978) and Mercer (1981) pointed out, project outcomes often emerge from ongoing dialogue between consultants and clients during the course of a project. Consequently, the distinction between a consultant's recommendation and a client's decision is often rather blurred, so it would be difficult to base a method of assessment on this distinction.

An alternative approach to assessing OR's impact is to aggregate individual projects, and to assess the impact over the long term. This is usually done by considering the work of an OR *group* as a whole. Informally, OR may be assessed by considering the OR group's image - the reputation that it has within the client organisation (Thornton, 1990) [NB - in the case of in-house OR, as in this research, the client

organisation is also the host organisation.] More formally, it may be done by comparing the OR group's *'lifestyle'* with that expect of a group in an *'ideal'* state. It is often considered that OR groups should aim to reach and settle into a period of *maturity*, in which the group has a large number of members, and is 'visible' within the hierarchy of its host organisation (Houlden, 1979, Ackoff, 1979).

These methods overcome some of the difficulties of making short-term assessments. They do, however, present a number of difficulties of their own. As Keys' (1991) metaphorical analysis shows, assessment of OR's role within an organisation depends upon identifying a particular conceptualisation of organisational life which the OR community can accept as generally most appropriate for this purpose; all metaphors highlight certain aspects of organisational life and conceal others. So far, the 'organismic' metaphor, and the life cycle concept, have proved most popular. This metaphor suggests that the aim of the OR group is to respond to its immediate environment, and to grow in size and strength. It will probably 'succeed' in doing this if the people who have authority and power within the host organisation consider the development of a large OR group to suit *their* purposes. If OR people aim simply to work for the good of the most powerful people in their organisations, or to secure lucrative careers for themselves and their colleagues, then these methods of evaluation will prove helpful. Again, a particular notion of OR's 'customers' is being assumed.

Most of the methods of evaluation considered above focus upon the outcomes - or *ends* - of OR work, whilst little consideration is given to the *means* used to of achieve these. It is possible, theoretically, for an OR group to become extremely 'successful' within its organisation without actually doing any OR. It could be argued that doing *something* 'successfully' is more important than striving to do OR which is defined according to some particular ideal. If, however, it is to be "OR" *per se* which is being evaluated,

rather than merely the fortunes of a group of people who started their careers as OR practitioners, then it is essential to relate organisational success to the practice of OR, and to set some boundaries which define the nature of OR practice. To some extent, this is achieved through Conway and Holland's methodology, whereby a group's position in a 'life cycle' is linked to its project portfolio: it is only those groups with gently evolving fields of work (as opposed to those which specialise, or those with a high turnover of clients), which are labelled as 'successful'.

Polding and Lockett (1982) suggest that OR practitioners may seek greater "institutionalisation" of OR (and a more 'mature' position in a life cycle) because they believe that this will increase the likelihood of client managers responding positively to OR projects, but that client managers may not confer with this view. This desire for institutionalisation has more to do with "the need of practitioners for institutional security" than with the actual impact of OR work.

There is a well-grounded argument for rejecting the 'OR group's survival' approach to evaluating OR. The diffusion of OR techniques into other parts of a client organisation has often been noted, and considered as a sign of maturity of OR (Radnor, Rubinstein and Bean, 1968, ORS, 1986). Eilon (1980) suggests that

> "one way to view this trend is to suggest that OR has been so successful in its application that it has now been warmly embraced by all functions of management to become an integral part of their planning and evaluation procedures, and, viewed in this light, we should congratulate ourselves on a remarkable achievement."

The practitioners in this research hoped that their skills and methods would 'rub off' onto their clients. However, an OR group which is 'successful', in this sense, may not be rewarded by higher status; instead it may be considered superfluous in view of management's newly acquired skills.

11.1.2 Other approaches to evaluating OR

In chapter 6, I described one aim of ORers' problem-helping approach as being 'to engineer less-trauma-prone environments'. In theory, relative scarcity of trauma-prone environments might indicate that OR had been done 'successfully'. However, one would need to devise a sophisticated methodology for assessing the state of decision-making environments. One would also need evidence that improvements were due to OR activity.

An interesting contribution to the discussion about the impact of OR was made by an OR practitioner in this research who suggested that the career paths of former members of the OR group provided a measure of OR's influence and reputation within its organisation. There are, however, many other variables involved in this situation. Moreover, the time lag between career success and OR practice make this kind of assessment extremely unreliable.

OR practitioners' own satisfaction in their work is undoubtedly relevant to their assessments of OR per se. The practitioners interviewed in this research wanted, among other things, intellectual stimulation, an opportunity to apply their education, the thrill of 'solving' problems, and the pleasure of interacting with lots of interesting people. If their chosen careers meet these needs, then OR has achieved something of value.

The salaries of OR practitioners undoubtedly contributes to their job satisfaction, and are relevant to the above discussion. They also provide a measure of *OR's worth* to client organisations. Surveys such as that by Hare (1989) indicate that OR, as a 'profession', receives healthy recompense from its employers. However, as with other 'survival' methods of evaluation (see above), high salaries need not be assumed to indicate that OR work has *value* in any but the financial sense.

Other attempts have been made to assess the impact of the OR movement *as a whole*. Thornton (1990), for instance, points to OR's general influence over management methods, particularly in the management of information systems. However, this kind of approach consists largely of aggregating assessments of several OR groups, so the earlier criticisms apply here too.

As a consultancy practice, OR is intended to have an impact upon its environment, so most attempts to assess OR have focussed on its impact. There are, however, other factors which could form part of an evaluation approach. For instance, the idea of *'intrinsic quality'* in OR work has an intuitive appeal to practitioners; they feel that they *know* when their work is 'good'. Such judgments usually concern either technical correctness, or proper social skills. The latter are implicit in Thornton's (1990) assessment of "the evolution of the product [i.e. OR] itself": he comments that "there is now a widespread appreciation of the essentially consultative nature of OR". It is implied that ORers now have a methodology which is intrinsically *better*. This is an *a priori* judgment, similar to the one which lies behind this research - namely, that OR is a consultancy practice, and *should* be treated as such. By contrast, the 'impact' approaches to assessment tend to be *empirically* based.

11.2 Choosing a Method for Promoting Effectiveness

In making the criticisms in the above sections, I am not arguing that the various approaches to evaluating OR are totally unworkable, or even that their benefits are outweighed by their shortcomings. However, it should be clear that even the concepts of 'value' and 'effectiveness' are somewhat problematic. To devise suitable methods of assessment, based on these concepts, and to combine these methods with descriptions of OR in various settings, in order to establish prerequisites for 'effective' OR, would be a major

undertaking, and could not realistically be attempted with a sample as small as the one used in this project.

The concepts of 'value' and 'effectiveness' are used in the work of Argyris and Schon (1974), who point to the role of *professional education* in increasing effectiveness. The attraction of this work is that it suggests that *it is possible to promote effectiveness without conducting elaborate empirical studies.* This seemed appropriate to the scope of this particular research project.

Another reason for considering the role of professional education in promoting effectiveness was that, during 1989, a convenient opportunity arose to develop and teach part of the MSc in OR at Sheffield City Polytechnic (SCP). The teaching module, which became known as OR "practice and process", does not owe its *origin* either to this research project, or to the work of Argyris and Schon. However, original intentions for the module *content* were broadly consistent with the subject of this research project, and the intentions for the *role* and *style of delivery* of the module were consistent with both of these areas of work.

The next section of this chapter summarises the ideas of Argyris and Schon which I have utilised in trying to promote effective OR through education.

11.3 The Work of Argyris and Schon

Central to the work of Argyris and Schon is the notion of a "theory of action" (Argyris and Schon, 1974). A theory of action is the formulation in an *individual's* mind that "in situation S, if you intend consequence C, do A, given assumptions $a_1 \ldots a_n$", though a theory may be less sharply articulated than this phrase suggests. We may distinguish between someone's "espoused theory" of action, and his

"theory-in-use" which is the theory which actually governs his behaviour.

Argyris and Schon define a number of qualities of theories of action, namely:

Consistency - Is a person's theory-in-use internally consistent? Is his espoused theory of action internally consistent? A theory may be inconsistent if either consequence C, action A, or the set of assumptions (viewed as vectors) are internally contradictory.

Congruence - Is a person's theory-in-use (and, therefore, his behaviour) consistent with his espoused theory? Theories may be incongruent if theories have common assumptions and intentions but suggest different actions.

Effectiveness - Does behaviour according to a theory-in-use actually produce the desired result? A theory may prove ineffective is action A is not capable of producing consequence C, given a particular set of assumptions. It may also be ineffective if a situation is misread, or if a theory is internally inconsistent. Ultimately, a theory is effective if there is congruence between a theory and the behavioural world.

Testability - Is it possible to test the effectiveness of a theory-in-use? This may be difficult if a theory is poorly articulated, or if it is self-fulfilling. Testing also requires the ability to understand and to reflect upon the behavioural world. Consistent and congruent *espoused* theories are useful in the process of testing.

Value - Is the behavioural world which is created by a theory actually of value, in some sense? Is consequence C desirable? Clearly, the meaning of "value" depends upon some notion of good and bad, or at least of accountability. I have indicated, in chapter 2, that I apply specifically biblical

principles in this area, though other assumptions about value could, of course, be made.

Two other important concepts in Argyris and Schon's schema are *skills*, which are "dimensions of the *ability to behave effectively* in situations of action" (Argyris and Schon, 1974, emphasis added), and *learning*. Following Ashby (1952) it is possible to distinguish between 'single-loop learning', whereby new action strategies are learnt to achieve given consequences, and 'double-loop learning', whereby intentions, as well as actions, are reviewed. Thus learning is critical to effectiveness. Moreover, double-loop learning is relevant to value.

11.4 Professional Education

Argyris and Schon turn their attention to the "design of learning environments" - i.e. to the development of educational systems. Here, the notion of 'professionalism' is important: following Palmer (1973), Argyris and Schon consider that a 'profession' is marked by its origins in which 'technique' is bound up with "a faith professed - that is, with values to be achieved through the activities of the profession" (Argyris and Schon, 1974. The religious overtones in this quotation were deliberate.). This is contrasted with "the engineering paradigm" in which 'effectiveness' is all important, but 'value' is neglected.

Operational research may be regarded as a form of "engineering" (in this sense), so that single-loop learning is sufficient for increased ineffectiveness. Alternatively, it may be considered as a "profession", in which case operational researchers should be concerned, not only with effectiveness, but also with value. This is the perspective that I am adopting. Consequently, as Argyris and Schon put it,

> "a .. fundamental response is to help professionals .. to learn [i.e. double-loop learning]. This will make the manipulation of technique confrontable, enhance free choice in the solution of technique, and link the pursuit of humane values to effective practice. This .. requires a new design for the professionals and for professional education".

It has been widely recognised that whilst operational research appears to be quite effective, and 'successful', in *practice*, the 'science' of articulating *theories* of OR is under-developed (eg Bryant, 1988, Pidd, 1985, Daniel, 1985). OR is an example of what Argyris and Schon call a profession with "few espoused theories, but effective theories-in-use":

> "Mystique is central to such professions .. The polarisation of practice and theory may be most extreme under these conditions. The effective practitioner does not understand why he is effective but has observable evidence that he is".

To aid this kind of profession, educators must

> "try *to surface implicit issues, publicly test hypotheses, identify self-sealing processes, and value double-loop learning*" (Argyris and Schon, 1974, emphasis added).

The description of OR practice which is contained within the main body of this thesis (chapters 4 to 10) is relevant to the *content* of theories of action for OR. The *framework* which undergirds this description is relevant to what Eden and Sims (1979) call "a theoretical framework or heuristic which can guide the continuous and reflective development of theories of action". *My deliberate focus on the actions and intentions of individual OR practitioners lends itself to learning* in a way that would not have been so easy from other perspectives. Furthermore, promotion of double-loop learning involves raising questions of *value;* in my research methodology, the concept of value is recognised explicitly.

In summary, this research project seems to provide an appropriate basis for the design of an educational programme.

This chapter continues by describing the development an appropriate learning *environment* - i.e. mode of delivery - for professional education in OR. The following sections describe the development of the OR "practice and process" (P&P) module, and the results and feedback from its first delivery during the academic year 1989/90. [The module has remained largely unchanged up to the present time (1993), so I shall describe it in the present tense.]

11.5 Professional Learning Environments

The basic principle behind Argyris and Schon's ideas about learning environments is that the capacity to build theories of practice, and to learn "can be acquired only *by engaging in practice and reflecting on the meaning of that experience*" (Argyris and Schon, emphasis added). This points to what they call "clinical education" which may consist of rehearsing theories-in-use either in a *simulated* environment, or in *real world* "field practice".

Professional experience should be designed and administered so that 'student' professionals not only get a taste of life in the real world, but also "learn to become more reflective under real-time conditions so that effective ad hoc theories of action can be created and tested" (Argyris and Schon). In this, they require the help of educators (eg university and polytechnic lecturers) who are competent at elucidating and articulating the theories of action which are prevalent amongst their students, and within the wider professional community.

In 1987, the Department of Applied Statistics and Operational Research (now part of the School of Computing and Management Sciences), of Sheffield City Polytechnic (now Sheffield Hallam University), along with Sheffield Business School, began to delivery a "Masters" course in OR by distance learning. Students enrolled on this course study part-time for three

years. The course is divided into "modules", most of which consist of either a set of written booklets - "units" - or a week-long residential course, plus background reading.

In the final year of the course, the students undertake a 'live' OR consultancy project, either within their present employer organisations or elsewhere. [NB - Not all of the students are already employed in OR, though most are working in related fields. It is quite common for an MSc course to be used as a 'stepping stone' into OR.] In parallel with the project is a module entitled OR "Practice and Process" which is intended to act as a heuristic device, to facilitate students' learning from their experience. The professional experience project and the Practice and Process module, in combination, constitute the type of professional learning environment recommended by Argyris and Schon. The Practice and Process module was first delivered in 1989, and its design grew out of the latter stages of this research project. The design of the module, and the results of its first delivery, are described in the following sections.

11.6 OR Practice and Process

A number of principles guided the development of the "Practice and Process" (P&P) module:

Complement to the rest of the MSc course

As with most university and polytechnic OR courses, the first two years of SCP's MSc in OR are largely concerned with *models and technology*. Specifically, there are modules on simulation, optimisation, and principles of modelling. There are also modules on management, and on consultancy. The P&P module does not deal with OR technology itself, or with the social context of OR, but addresses the *use of technology within the context of a problem-helping relationship*.

Master of Operational Research

As noted above, in recent years, 'Masters' degrees have been used as conversion courses - to allow a graduate in a one discipline to switch to the 'discipline' of OR. Indeed, many students on the SCP MSc in OR are not actually working in OR when they take the course. However, the MSc is literally intended to raise students to the level of "master" of operational research - perhaps to the level of 'professional'. In particular, the third year of the course, consisting of the live project and the P&P module, converts a postgraduate diploma (achievable after two years) into an MSc.

In order to achieve this, the P&P module is not aimed at adding to the students' bag of OR techniques. Instead, it is aimed at *developing students' ability to think about their work, and to learn from their experience; to learn the skills through which they may become effective and valuable as social actors.*

Complement to the MSc project

In particular, the P&P module is intended to run concurrently with the live project which students conduct in the third year. The project can provide the experiential data to aid students in reflection during P&P, and help them to test and evaluate the ideas presented in the module.

Soft OR methodologies

As well as addressing social and methodological issues in OR, generally, the P&P module is used to discuss the use of soft OR methodologies which were specifically designed to deal with many of the issues raised within the module. The soft OR material was, in some ways, a sideline, but its inclusion is consistent with the overall aims of the module.

11.6.1 Design and delivery of the module

The P&P module consists of ten, largely self-contained, written "units". Each includes about 3000 words of text, a number of practical examples as illustrations, and a substantial bibliography to help the students to look deeper into the issues raised within the unit.

One of the most important elements of the module is the inclusion of between two and five *practical exercises* within each unit. The aim of these exercises is to encourage the students to reflect upon their own experience, and to test the ideas presented in the units. Students are advised that they will benefit from spending time over these exercises, rather than trying to 'do them' as quickly as possible. In contrast to much distance-learning material, within P&P it is not possible to accompany these exercises with "right" or "specimen" answers. Success in P&P consists in *right processes of reflection*, rather than in right answers. However, most exercises are followed by a discussion which attempts to anticipate some of the issues and problems that might be encountered in doing the exercises.

In the first (1989/90) running of the P&P module, students were examined through a single written piece of work, about 3000 words in length. They were asked to reflect upon various social and methodological aspects of their MSc project, and to explain how they dealt with the issues raised, most of which are discussed in the written units.

11.6.2 Summary of the "Practice and Process" material

This section summarises the *content* of each of the ten written units which form the practice and process module.

Unit 1 : Introduction

.. explains what the OR practice and process module is about, how it relates to the rest of the MSc course, and how the written material can best be used. The pyramidal model (consultant, client, problem and technology) is introduced. There is a brief discussion of the notion of 'the process of OR'. There is a summary of each of the remaining course units.

Unit 2 : Methodology

.. introduces the idea of a *methodology* - as "systematic understanding of the methods [an OR practitioner] might use to deal with people, problems, and technology". The concept of methodological *choice* is introduced.

The unit continues by addressing the role of models, and issues of choice between them. Factors such as model speed and accuracy, simplicity and complexity, customised models, and choice of search method are discussed. Chapter 9 of this thesis is relevant, here.

Students are asked to reflect upon the roles of various technological aids in a recent project, and the choices made.

Unit 3 : Interactions in Organisations

.. views organisational life *as drama* in order to draw attention to the centrality of people and relationships in OR practice.

The notions of 'cast' and 'role' are used to identify the variety of people who become involved in OR practice, and to consider the nature of their involvement. The idea of a 'script' is used to focus upon the nature of interpersonal interactions, and the reasons why they take particular courses. Chapters 4 and 8 of this thesis are relevant here.

Students are encouraged to use these ideas to examine their own organisational interactions. They are asked to make and examine transcripts of conversations.

Unit 4 : Communication in Organisations

.. is concerned with the nature of communication in a variety of settings which are relevant to OR practice. Listening skills are stressed, in order to promote understanding and sensitivity in consulting.

The notions of content, process, context and language are discussed with reference to interpersonal and group *meetings* in organisations. The unit then focuses on the *listening* aspect of communication: firstly, the paucity of listening, as a social skill, is discussed and demonstrated; secondly, the idea of tailoring presentations to particular audiences is introduced. Some general 'dos' and 'don'ts' of speaking and writing are suggested. Chapter 8 of this thesis is relevant, here.

Students examine roles played during recent meetings, and recent attempts at written communication. They also practice listening.

Unit 5 : Decisions and Problems

.. criticises the 'rational' textbook model of decision-making. Emphasis, here, is on making progress in the context of imperfection.

The incidence of social decision-making processes, uncertainty, imperfect information, ambiguous objectives, and subjectivity in problem identification and definition are discussed. Chapter 5 of this thesis is relevant, here.

Students are asked to consider the relevance of these issues to their work, and to consider how they might best be addressed.

Unit 6 : Problem-solving Consultancy

.. introduces a typology of problem-solving consultancy. Similarities and differences between various management services are discussed with reference to this model.

Problem-solving consultancy is defined in terms of problem *'locus'* (where a clients feels 'the problem' is located), solution *'focus'* (the nature of the consulting relationship, and the sort of leverage that the consultant applies to the problem and its environment) and *'hocus-pocus'* (the tools and skills used by the consultant. OR is described in these terms, and is compared with counselling, organisation development, management consultancy, organisation and methods, decision support systems, and expert systems. The role of OR's technology in problem-solving is also discussed. Chapter 6 of this thesis is relevant here.

Students are encouraged to consider the ways in which they try to help clients, and to consider the impact of their technology. They are encouraged to consider how they might learn, and apply ideas from other consulting approaches.

Unit 7 : Soft OR - part 1

.. discusses the principles guiding the development of soft OR approaches (many of which have been introduced in earlier units), and examines the *Strategic Options Development and*

Analysis methodology to see how it deals with subjectivity, pluralism, qualitative data, and decisions.

The cognitive mapping technique, and its application to written text, live conversation, strategic action planning and groupwork, are discussed. Students practice working in these various ways.

Unit 8 : Soft OR - part 2

.. continues with the soft OR theme by discussing the *Strategic Choice Approach* and *Robustness* methodology.

Techniques for analysis of interconnected decision areas and management of uncertainty are discussed, but the emphasis is on the nature of decision processes, the 'shape' of the SCA methodology, and the choices made by a consultant.

Students follow through a worked example, and then apply the ideas to a decision problem that was introduced in a simplified form in an earlier unit.

Unit 9 : Systems Thinking

.. introduces the concept of a system, and the ideas of thinking of organisations *as* systems, or *with* systems.

The concepts of interrelated parts, inputs and outputs, purpose, boundaries and control are discussed with reference to organisations. The possibility of using systems ideas for problem-solving consultancy is discussed, and *Soft Systems Methodology* is described.

Students practice using systems models to describe organisations, and consider the use of alternative definitions of systems, for use in a pluralist context.

Unit 10 : OR in Context

.. discusses the context of an OR project, with reference to the client organisation as a system, and with reference to ongoing client relations.

The concepts of *'fields of works'* and *'the dynamic model of the OR process'* are introduced. Issues of social responsibility in OR, and conceptions of OR as a scientific activity, and as a social activity, are discussed. Students are encouraged to recognise their parts in adversarial processes, and to question the ultimate *value* of their contribution. Chapters 8 and 10 of this thesis are relevant here.

Students are asked to consider the relationships between various small projects within a large organisation, and the nature of the relationships which provide the social backdrop to OR work.

11.7 Evaluation of the P&P Module

This section is based partly on the written assignments which were used to measure students' performance, and partly on feedback from the students after the course had been completed. Eight students completed the third year of the MSc course in 1990. Each of these completed a report on the professional experience project, completed the P&P assignment, and received a questionnaire requesting feedback from the P&P module. The questionnaire covered issues such as how the students had used the written material, how interesting and helpful they found each unit, how well they thought the course related to their project work, and how they felt about the methods of delivery and assessment.

For the P&P assignment, students were awarded marks ranging from 42% to 70%, with a mean of 57%. Interestingly, only the

four students who had achieved over 60% completed and returned the feedback questionnaire. Consequently, the feedback results are heavily biased towards the methods, thoughts and feelings of successful students.

In the assignment, most students demonstrated considerable ability to analyse the social origins and organisational context of their project. Most were able to reflect on their reasons for choosing that particular project. Most students were able to explain their choice of method, although one explained that he used the same method that his consultancy group always uses. Some students were aware of the way that their models were likely to be used within their organisation, and of how they fitted in with other models.

Some students were able to distinguish between different client roles, and different personalities, and to consider how they should relate to these individuals. However, students' ability to describe social interactions was generally poor, and their readiness to consider the social consequences of their work was extremely variable. In other words, questions of value were not addressed particularly well; improvement in this area is critical to "professional" (double-loop) learning.

Some students, though not all, showed that they had understood the P&P material, and that they understood how to apply it, either in practice or in reflecting upon practice. Some major faults of the weaker students were to avoid directly answering the assignment questions, to substitute proper answers with technical information which was entirely irrelevant, or do address important methodological issues at only a superficial level.

Feedback

In general, students read the 'units' whenever they could find the time, in the midst of (often unrelated) full-time jobs,

and professional experience projects. Two students did "most" of the exercises, and two did only "a few". Most found the exercises to be "quite useful", although two said that they preferred the 'quick' exercises and those which were accompanied by specimen answers, as opposed to those which depended upon serious reflection. Only one of the four students who provided feedback had followed up any references from the bibliographies. Reasons for not doing so included "I don't like reading", "no need, because the notes were excellent", and the lack of a nearby library.

Students were asked to evaluate each of the ten units according to their relevance to the students' present jobs, usefulness in their present jobs, level of interest in the context of their present jobs, and relevance to the MSc project. Only three of the students answered these questions. One of these had just begun work as a lecturer at SCP, so his answers concerning his 'present job' are rather misleading. Nevertheless, the feedback provided some information which can be combined with information from the P&P assignments themselves:

Units 3 and 4 (Interactions and Communication in Organisations) were considered most relevant and useful to students in their present jobs; *parts of* units 2 and 6 (Methodology and Problem-solving Consultancy) were also considered relevant. Unit 6 was most stimulating, followed by units 2, 4, 7, 8 and 9. Unit 4 was considered most relevant to the MSc project, followed by units 3 and 8 (on strategic choice and robustness). These feedback results are consistent with the assignments themselves which showed much use of units 3 and 4, some use of units 2, 6, 8 and 10, and very occasional use of units 7 and 9.

It is apparent that the units dealing with *general* consultancy issues had most (immediate) impact. However, students were not keen to describe interactions, or social consequences. As with the practitioners interviewed in this research (see

chapter 8), they seemed to value consulting skills primarily for their use in *manipulating* situations, to the consultant's advantage. The fact that some of the students were not employed in OR, when they took the course, is also likely to be a contributory factor in the popularity of the more general material.

Of the material which dealt specifically with OR, the *relatively practical* parts of units 2 and 6, which dealt with *choice of OR method* and *different problem-solving approaches within the management services*, made most impact. The theoretical parts of these units, and the theoretical unit 5, were unpopular, and appeared to have had little influence of students' thinking. Some students enjoyed the soft OR units (7 to 9), but others were pessimistic about the acceptability of these approaches in practice.

The intention had been to deliver P&P in parallel with the MSc project. However, many students did not start their projects until near the end of the P&P module. Consequently, these students could not reflect upon the project experience while studying P&P. Furthermore, as the assignment depended on such reflection, some students were at a considerable disadvantage. [When marking the assignments, I commented on one student's "ability to stand back from his work". It later transpired that he had hardly *done* any work!] However, all of the students were able to use the P&P course to help them to structure and write their project report. Two students (of the four providing feedback) remarked that this was one of the major benefits of P&P. On the influence of P&P upon the nature of project reports, an external examiner for the MSc course remarked recently (now that *three* sets of students have studied P&P) that "comfortably over half - I suspect *all* - of the project dissertations are substantially different from how they would have been otherwise".

A number of other comments were made about the content or mode of delivery of P&P. There was a general feeling that the

module could be improved by making it more *interactive*. Two students suggested that this could be achieved by using two assignments, rather than just one at the end of the module. One suggested that each unit could have a feedback sheet enclosed - enabling lecturing staff to monitor students' progress at each stage. This would, presumably, also require brief responses from the staff in order to provide the students with continuous feedback. Students commented that the written units were well written, and entertaining.

One student commented that P&P made him more aware of the "approximations, simplifications and decisions" that he makes. "It raised many issues that I was unaware of. I do not feel it has provided many answers". Another student commented that "reading through the text, an experienced OR practitioner may occasionally think that it is all common sense. This must mean that it is a valuable and accurate description of OR practice and process". Comments such as these show that, on its first delivery, P&P was at least partly successful. However, it is clear that some improvements could be made. These are considered in the final section.

11.8 Improvements to P&P

Possible improvements to the P&P course (or equivalent) can be divided into those which relate to the course *content* and those which deal with the course *method of delivery*. I shall begin by considering improvements to the content of the written material.

In general, improvements would lead to easier development of workable methodologies for mainstream OR practice. Parts of units 2 and 6 were successful here, and these areas could be developed more fully: The same sort of discussion and guidelines that unit 2 provided for model choice could be provided for methods and technology in a much broader sense. Material such as chapter 9 of this thesis, and Friend and

Hickling's A-TOPP framework could be useful here. Students valued the discussion of various approaches to problem-helping, as encapsulated in different management services. These related consultancy practices are not examined elsewhere in the MSc course. It is possible that further consideration of DSS, ES, OD and management consultancy could be beneficial, although the relevance to workaday OR would have to be made clear.

It is not clear whether the theoretical address in unit 5 is influential or not. It is possible that the same issues could be taught better by example - i.e. by raising them within (semi-)fictitious examples from OR practice. The soft OR methodologies are the only suggested 'solutions' to the problems raised in unit 5. Students would almost certainly benefit from indications of how (and to what extent) the same issues can be handled within the boundaries set by their present repertoire of working methods. Moreover, the soft OR units (7 to 9) are the only ones dealing with *methodologies as wholes*; as the PxC methodologies, integrating skills for dealing with content and process, which Eden (1985) recommends.

Problems were encountered because some students were not already full-time operational researchers, and because the MSc projects were not under way during the delivery of P&P. In these circumstances, it is inappropriate to invite students to 'reflect on a recent OR project'. It is also inappropriate to base the P&P assessment on the project work. These problems can by addressed by recognising that the process by which students become able to articulate and learn theories of practice is only *partially* complete by the end of the P&P course (i.e. the end of the first semester in the final year). The P&P exercises and any assignments undertaken at this stage could be artificial in nature - being literature or theory based.

The burden of assessing students' learning *in practice* may be shifted to the second semester, and may even be formally recognised as part of the project work. This suggests a more *holistic* approach to the third year, with the *P&P delivery and assessment being integrated into the project supervision arrangements*. This would also make the process more *interactive*: Lecturers/supervisors would then be in a better position to help students to articulate and develop their own theories-in-use. The use of two assignments (an "artificial" one at the end of the written material, and a practical one based on the project) provides greater interaction. The idea of continuous feedback and comment, during the delivery stage, is also attractive. This has another advantage: although the easy-reading style of P&P was appreciated by the students, it does tend to suggest that P&P is a 'mickey mouse' module. Continuous correspondence would make it possible to ensure that students are engaging with the written material at the right 'level'.

11.9 General Recommendations for Educational Programmes

The previous section addressed changes which could be made *to the P&P course, specifically*, following the experiences of the first batch of students. Now that this research project is complete, it is also possible to combine its findings with the experience of conducting the P&P course, and to make some general recommendations for OR education and training.

Most postgraduate and undergraduate OR courses now cover subjects such as "consultancy skills", and contextual subjects such as "organisational behaviour". However, these types of subject are taught separately from OR 'techniques' which invariably comprise the larger part of degree courses. This common separation of teaching into technical and non-technical parts may explain why OR practitioners separate these issues into distinct provinces of thought. In OR education, it seems to be assumed that the effect of these courses is additive -

i.e. that students can adequately combine separately taught issues into a coherent whole. The testimony of this research project is that they may not, in fact, be able to do this.

There is a need for *holistic* teaching in OR - i.e. for courses which present technical material and non-technical material as conceptually distinct, but practically inseparable, aspects of the same overall process. The practice and process module described in this chapter is an unusual example of teaching material which attempts to teach the whole OR process, but it is not only through this type of course that holistic thought can be encouraged: it is, for instance, possible to teach mathematical programming or simulation in ways which do not disguise the reality of their use as instruments in a social problem-helping process.

The Science and Engineering Research Council (1989) have recommended the following structure and contents for MSc courses:

Obligatory	Expected
Techniques:	IT: Basic computing
Simulation	Databases
Math. Programming	Expert systems
Statistics	Man/machine interface
OR methodology	Consulting:
Project	Data collection
	Speaking & writing
	Project man.
	Org./Business Context

Mingers (1991) suggests that consulting skills, and basic computing (including spreadsheets) should be obligatory, and that mathematical programming and stochastic modelling need not be. The resultant balance would a more pleasing one: there would be considerable emphasis on consulting; only statistics and simulation would be obligatory 'techniques'

(reflecting the popularity of these techniques - see chapter 7); basic computing and applications would be included (reflecting the common usage of spreadsheets). Nevertheless, only "OR methodology" presents an opportunity for holistic teaching.

As Bennett and MacFarlane (1992) note, most students on MSc courses already have first degrees in mathematical subjects. In view of this, it may be appropriate to *over*-emphasise non-mathematical aspects of OR. Perhaps the best way of preparing these students for the heuristic, descriptive, modelling that is commonplace in OR practice is through courses which focus on hypothetical problems and data sets, rather than on potential solution techniques. It is, of course, very difficult to *teach* ad hoc methods; the very term "heuristic" betrays a feeling that progress *is* being made, but that the precise nature of the process at work cannot easily be articulated. Such 'methods' are truly *craft* skills, and may only be learned through experience, and apprenticeship.

The relationship-based problem-helping nature of OR practice may be very difficult to communicate through intensive full-time courses; any practical experience - 'the project' - is necessarily brief. It is possible that courses on 'consulting' and 'OR methodology' could be adapted to reflect the historical and social context of individual projects. Distance-learning courses (such as the one at Sheffield Hallam University) provide opportunities for students to be constantly reflecting upon, and learning about, long-term methodological issues. This, however, depends upon students being already engaged in OR practice, rather than attempting to 'convert' from another occupation.

An MSc in OR is now commonly regarded as an entrance qualification to the 'profession'. Once established in the profession, OR practitioners seek no further education, and universities are unable to offer any higher qualifications. A one-year (or equivalent) 'conversion course' in OR cannot

properly be regarded as leading to a 'masters' qualification since, far from being *masters* in their practical subject, successful students may not yet even have been *employed* in OR. A true masters' course would elevate students from 'OR practitioner' to 'OR professional', by engaging students in serious reflection about the nature of their practice, and about the values which it imports. Such education may not hold much attraction to post-modern Britain.

Chapter 12

CONCLUSIONS

In this final chapter, I offer a summary of what I believe this research project has achieved. In the first section, I shall summarise the most significant findings about OR practice that have been made during the project. I shall then outline the nature of this research's contribution to methodological development. In the final section, I offer my reflections on the way the research has been carried out.

12.1 The Nature of OR Practice

I stated, in section 1.6, that I aimed to describe OR practice with individual OR practitioners *"centre stage"*, to describe their working lives *as wholes*, and to emphasise the *consulting* nature of OR. I believe that this has been achieved, with respect to *in-house OR workers*. Some of the findings are original, and offer fresh insights into the nature of OR practice and methodology; things that have been brought to light through the particular methods of study adopted here. Other findings can be more easily related to previous/present understandings of OR. There are no identical studies with which to make comparisons. The most wide-ranging study of OR practice has been that undertaken by the OR Society's Commission on the Future Practice of OR. This research has offered the chance to look more deeply at some issues covered by the Commission.

12.1.1 OR and problems in a social context

The model of decision making that was developed in section 4.2.4 has proved to be *critical* to the subsequent description of OR practice. Here, clients are portrayed formulating theories about their environment, and proposals for action. Within bureaucratic constraints, they submit their proposals, in interaction with their colleagues, for negotiation of decision commitments.

Problems have previously been described in relation to a social context by Eden and Sims (1979) and Bryant (1989), and, in some respects, their ideas have not been furthered here. However, their work is not primarily concerned with *describing* OR practice.

The *context* of OR work is pluralist, and even coercive in nature. However, this nature is not fully reflected in practitioners' *definitions* of problems. They are thought to be *imbedded* in individual managers' intellectual processes of theory and proposal formulation, rather than in social/political processes of decision and action. Moreover, problems are thought to be *rooted* in complex 'object' systems. These tendencies in defining problems are consistent with many characterisations of OR methodology and, in particular, with Jackson and Keys' view of OR as applicable to "mechanical-unitary" problem contexts.

'Problems' in OR methodology are not, however, insulated from 'softer' considerations: Section 5.4 shows that behavioural issues, social relations, political constraints and uncertainty of various kinds are *relevant* to problems. However, they are often considered to comprise a secondary, 'practical', problem which has to be overcome after progress has been made with the primary, 'theoretical' problem. The two types of concerns are separated into two distinct provinces of thought: OR *per se* is considered to be

appropriate for dealing with 'the' problem, whereas consulting skills, contextual knowledge and political nous are used to deal with practicalities.

12.1.2 OR as a consultancy practice

The ORS Commission "found that most practitioners hold the view that social and political skills are of more consequence in the practice of OR than in most apparently related activities" (ORS, 1986). The Commission recommended that OR education should pay particular attention to the development of such skills. During the 1980s and 1990s, the OR Society has organised many popular courses and meetings which have addressed consulting issues and soft methodologies (which are often based on theories of consulting); many MSc courses now offer substantial development of consulting skills and contextual knowledge.

This research indicates that practitioners *are* indeed aware of consultancy and process-related issues, and regard these aspects of their work to be critical to their overall effectiveness. The notion of "consultancy" is very popular. This is partly because it has connotations with expertise, 'fast bucks and fast cars', and has projected a generally attractive *image* for professionals in Thatcherite Britain. However, through the problem dualism described above, it appears that the development of consulting skills is 'added on' to the development of problem-helping methodology, rather than forming the basis, or an integral or pivotal part, of it.

Practitioners' 'theories' of consulting, as described in chapter 8, consist largely of ideas that have long since been part of OR 'folk wisdom'. Practitioners' awareness of their approaches to consultancy appears to be limited, and this research's findings about their consulting practice are quite mundane. However, one finding gives cause for concern: despite recognising the social and political context of their

problem-helping activity, ORers' concern with regard to relationships seems to be limited to *resolving their own consulting difficulties* (section 8.1); the ORers' in this study paid relatively little attention to understanding clients' felt needs.

In Churchman and Schainblatt's terms, ORers act as *"persuaders"*. This does not seem entirely consistent with the altruistic intentions expressed in section 3.4. Interestingly, Tichy (1974) found that operations researchers in the US cited aims of improving efficiency and formal structure, and *acted* in accordance with these aims. In this case, it was *OD* consultants who espoused humanistic, altruistic ideals, and failed to live up to them. There is evidence that contemporary OR practitioners may be a new breed, whose *ideals* reflect Eden's plea for the "future consultant" (Eden, 1985) to integrate content and process aspects in their methodologies, but whose working methods cannot yet *deliver*, or whose working environment is prohibitive.

12.1.3 OR as problem helping

A significant finding of this research, in terms of developing the OR community's corporate understanding of the nature of OR practice, concerns the notion of OR as a form of *problem helping*. The notion of 'problem solving' has, traditionally, been central to OR myth and methodology. However, when we consider that problems actually belong to *clients*, and that OR activity is grounded in ongoing relationships with clients, the notion of **problem helping** emerges. The way(s) in which ORers contributed in problem helping is then opened up for debate.

The evidence of this project is that ORers may make a variety of different kinds of contributions:

1 *Information* about the 'object system', to increase *understanding*, and aid the formulation of *theories*;

2 Information with implications for *action*, or recommended actions, to aid the formulation of *proposals*;

3 *Information technology* to assist in the gathering and management of information, for 1 or 2, above;

4 *Enhancement of intellectual capabilities*, to assist in management of information and interpretation of data, for 1 or 2, above;

5 Occasionally, *emotional support*, to assist in the management of information;

6 Occasionally, *participation in social processes*, either as *advocate*, or as *mediator*;

ORers may offer different combinations of the above contributions in different projects.

The work of Conway (1984) and Bryant (1988), as well as earlier work on 'implementation', has suggested that OR work may be relationship based. Moreover, the significance of relationships may *transcend individual projects*; projects may have technical, geographical, psychological or political interconnections, and can be viewed as parts of various fields of work.

I have portrayed OR as offering *long-term* help with problems, in the context of ongoing relationships. With this view, ORers' repertoire of problem-helping contributions can be broadened further: ORers make most, or all, of contributions 1 to 6 (outlined above) over a long period of time, in order

to *engineer less-problem-prone environments*, and to promote the continuation of mutually beneficial problem-helping relationships. *Each piece of OR work is not, therefore, necessarily concerned with formulating and solving a new problem*, as the "classical" model of the OR process (Conway, 1977) implies. Instead, ORers spend time *maintaining and developing* the information and IT contributions that they are contributing. They may even offer this 'technician' service to prospective clients in the hope of fostering good relationships. It is worth noting that, with the exception of 'recommended actions', all of the contributions 1 to 6, above, have *meaning and significance which transcends individual problem-solving projects*; *continuity* in organisational life requires a continuous response from operational researchers.

The argument above has important implications for the OR community's attempts to express OR methodology. Although the accuracy of the classical model of OR process has long since been suspect, it is still commonly assumed that all OR projects have certain common features, and that OR can be characterised, or even defined, in terms of these features. However, it is clear that projects can not be taken as standard units of analysis; instead, it may be possible to characterise OR in broader terms, considering the nature of the work done by a group of ORers, for various clients, over a long period of time - probably several years.

This research project has not led to any firm conclusions about how ORers spend their time, but some observations can be made:

- Not surprisingly, one of ORers' main areas of activity seem to be study of the object system which is causing concern to their clients. The findings of such study are translated into the information in 1 and 2, above.

- However, less direct approaches are also commonplace:
  - An ORer may study *a part of* an object system, with a view to increasing understanding of the whole;
  - alternatively, attention may be directed towards representations of the system (or part of it) in the form of *data* which has already been collected.

  In OR practice, well-structured or quantifiable aspects of a system are often the focus of attention.

- The development of appropriate *information technology*, with a view to continued provision of information, is a time-consuming occupation for many operational researchers. This type of work is sometimes undertaken purely and simply because clients (or, significantly, *potential* clients), have computing needs.

These activities are *directly* related to contributions 1 to 3, above. Contributions 4 and 5 are made only *indirectly*, through a kind of 'apprenticeship'. I have introduced the concepts of *solution leverage and focus* to describe these ways of working.

12.1.4 OR technology and its role

The ORS Commission (ORS, 1986) discovered "little explicit use of those mathematical techniques which are commonly associated with OR". This research project confirms these findings, and those of other researchers such as Carter (1987), Holland (1988), and Beasley and Whitchurch (1984). In fact, the 'techniques' used in contemporary OR practice are distinctly different from those presented in text books and other OR literature. The two most common tools, recognised as "techniques", seem to be *simulation* and *statistics*. Other common techniques include forecasting, financial modelling, and heuristics.

The evidence of this small study is that the use of 'ad hoc' *descriptive* tools, such as "heuristics", "financial models", "data models", and "basic stats", comprises a substantial proportion of OR practitioners' use of technology. With reference to problem-helping contributions, these tools are appropriate to information and IT provision, but do not *appear to* encapsulate methods for handling problems, or for developing action proposals. The names given to these popular techniques do not betray much in terms of the problem solving/helping processes at work. However, it is clear that *optimisation* is a less common approach than OR textbooks usually suggest.

Operational researchers use (what they term) a *structured approach*. It seems that this is not (as the phrase might suggest) a process of problem-helping, but is a *theme* with runs through OR work. The 'approach', which could be described as 'working with structure', involves a dialectic between hypotheses about relationships between parameters of a situation, and data relevant to it. Practitioners may develop their 'structure', either by reduction or by expansion, in the search for insight. This is essentially a *heuristic* approach.

ORers stated that most of their technology was used for *analysis*. However, it seems that it may actually be for *description of complexity*, or for *computation*. It is possible that these tools may incorporate more sophisticated technology, but confusion over terms like 'technique', 'model' and 'method' make this difficult to establish without conducting rigorous longitudinal studies. In line with the developing 'consultancy' ethos, OR practitioners make considerable use of *technology to aid two-way communication* with clients. Developments in IT, both in terms of speed and aesthetics, have helped here.

12.1.5 General characterisation of OR

I have commented, above, on OR practitioners' approach to problem definition, information provision, the main foci of their attention, and the nature of their 'structured approach'. The overall picture with emerges is one of OR as being *instrumental in clients' decision processes*. This is a radically different picture from the one that is often portrayed in management science literature. For instance, Jackson and Keys (1984) assume that ORers are in the business of "making models *of* situations" (emphasis added). Given this assumption, one could look at OR *models*, and deduce that ORers believe that situations have a particular structure or nature.

This research has not allowed detailed study of the thought processes which guide practitioners' work. However, its evidence confirms the ORS Commission's findings that ORers work in the spirit of 'scientific method', but actually have "little by way of a definable methodology" (ORS, 1986). The Commission found that "the main methodological drive [in OR practice] .. is pragmatism". This statement is supported by this research project; in the context of pragmatism, computable models and techniques are merely *instrumental* in the process of aiding clients in the process of theory and proposal formulation.

12.1.6 Relevance of this research in a changing world

The picture of OR practice and methodology that has emerged through this research refers to *in-house* OR consultancy; external consultancy and 'one man bands' were inadequately covered by the fieldwork. In-house work has been the 'norm' in OR practice over several decades. Furthermore, the ORS Commission found that "practitioners expect OR in practice to remain essentially an in-house activity", and reported that "the commission shares this expectation" (ORS, 1986).

However, recent socio-economic trends suggest that OR may not continue to be practiced in this way.

Since this research project began, many parts of many organisations have begun to be administered as relatively autonomous profit centres. In particular, many in-house OR groups have begun to operate as consultancy groups, adopting charging for project work. Some groups now carry out work for clients in other organisations. Practitioners interviewed in this research stated that they did not expect their work to be affected very much by the onset of charging practice, and there is, as yet, no evidence to contradict this expectation. However, the recent demise of some, apparently well-established, OR groups must should cause the OR community to ask whether its ways of working - specifically its approach to consulting - needs to be modified in response to new, competitive, environments. There is a further trend which could affect (or even revolutionise) OR practice and methodology: the 'demise' of OR *groups*, per se, is often accompanied by the dissemination of OR-type skills into various parts of an organisation. Not only could consulting approaches and OR management approaches need to adjust to this kind of situation, but the very idea of specialist OR workers (and, therefore, of OR *practice* as something which is done by 'OR *people*' - see chapter 1) may need to be reviewed.

It is generally recognised that social skills are particularly important to ORers operating as 'external' consultants. In view of this, one would expect the OR community to develop methodologies which have consultancy issues at their foundation. The notion of OR as a form of problem-helping consultancy, employing a repertoire of means and techniques, offers a more solid cornerstone for such methodologies than 'classical', textbook, methods of problem solving.

12.2 Methodological Development

The ways in which this research may contributes to OR methodology are summarised in this section in terms of the publication of the research findings, possible directions for subsequent research, and the utilisation of the research in OR education and training.

12.2.1 Publication of findings

This project utilised a very small sample of OR practitioners. The research findings require *testing* against a wider variety of practice. This requires *publication* in an accessible form, possibly through OR Society media. This process is already under way:

- On 24th March 1993, I presented a summary of my findings at an ORS study group meeting which addressed 'recent changes in the practice and methodology of OR, and any implications for OR education'. Although the majority of the audience were OR 'academics', rather than 'practitioners', responses gave some indication that this thesis offers a fair representation of the nature of contemporary OR. Concerns were raised about the lack of centrality of consultancy/process issues in OR methodology; these concerns echoed my comments earlier in this chapter.

- I have submitted to the Journal of the OR Society a written contribution, based on this research, to a current debate between Jackson and Mingers on the nature of problems and the relevance of this nature to OR methodology (see Jackson, 1990, Mingers, 1992, for instance). This 'viewpoint' is shown in Appendix D.

- I shall consider the preparation of at least one formal paper for publication in the ORS Journal, though this is unlikely to be published before 1995.

12.2.2 Further research

Further research could also be beneficial, both in terms of *wider*-scale study to confirm or modify the findings of this small-scale study, and in terms of *deepening* understanding of the nature of OR consultancy practice:

Wider study would entail the development of efficient methods for investigating complex issues such as the nature of long-term problem-helping consultancy and technology development and use.

- In-depth interviewing, as used in this project, could be used efficiently in appropriate circumstances: With a tighter approach to questioning, two researchers could, for instance, interview around fifty OR practitioners in a three-month period (based on an assumption of two pairs of interviews per interview per week).

- The main difficulties in conducting in-depth studies are *access* to organisations, and *relationships* with interviewees. It is likely that a study carried out under the auspices of the OR Society (such as the Commission's work) could enjoy relatively easy access. However, the notion of an 'official' study may lead interviewees to give 'official' answers to searching questions about their work.

- Jane Holland's research, at Hatfield, has illustrated that much information can be obtained through *self-assessment* methods. These methods are helpful in collecting *factual data* pertaining to *long-term issues*. For instance, the conduct of OR practice through fields of work, and the

development and implementation of various forms of technology, within this context, could possibly be studied in this way. However, subtle issues regarding OR practitioners' *methodologies* - such as their problem-helping rationales, and their choices of particular ways of working - require 'teasing out' through personal contact with practitioners. Sensitive issues concerning (eg) personal and political issues are also often communicated through stories and innuendo, rather than through facts.

- Issues related to problem-helping relationships are best addressed through *longitudinal* studies of OR practice. [This method was among those used by Conway, 1984.] This would involve a difficult choice of *sample*, and would require extensive *collaboration* with OR practitioners. It is conceivable that universities could actually *pay for* OR managers'/practitioners' time taken in a collaborative study. A financially viable project of this nature would probably have to rely upon copies of internal project administration literature, self-assessment questionnaires and 'diary notes' as methods of data collection.

- An alternative form of longitudinal study might utilise researchers 'on the inside' i.e. *action researchers* - actually working in OR: such researchers would conduct a reflective study on the nature of their practice as one among a portfolio of (OR) projects. Unfortunately, it seems unlikely that OR groups would consider it cost-effective to employ one of their members in this way. Links with the academic world, such as student apprenticeships (eg Bennett and MacFarlane, 1992) and 'teaching associates' (employed in universities, but also actively involved in OR practice) could provide the means for a study of this kind.

12.2.3 Education and training resources

At the conclusion of the previous chapter, I summarised the implications which this thesis, and the accompanying educational programme ("P&P") may have for future education in OR. In addition to these comments, there are two specific types of resource which could be influenced by the findings of this research:

Firstly, during the course of this project, I have been struck by the appalling dearth of university *textbooks* which reflect the reality of contemporary OR practice. I believe there is a 'market' for such a book, and that one would be of enormous help in OR education. The content and style of a textbook would necessarily be very different from the content of this thesis. A possible format is outlined below.

> A first part of this 'ideal' textbook would be comprised of case studies drawn from a wide variety of OR work. These studies would be non-technical accounts of OR work, emphasising the consultancy aspects of the work, and the ways in which OR consultants contributed to clients' process. Case studies would include accounts of the use of the contemporary OR 'techniques' (as described in chapter 7 of this thesis). Accounts of community OR and soft OR work also be included. Some of the studies would be reported on a relationship/fields of work basis, rather than a single project basis.
>
> A second part of the book would develop theory from the OR practice described in the first section. The model of OR as a form of problem-helping consultancy, as developed and used in this thesis, could be used, here. A third part of the book would include technical notes relating to the 'OR techniques' and other methods of work used in the case studies. A bibliography on each of these methods would give students a 'reader' in OR.

Another type of resource, which has a role in the overall process of OR education and training, is a careers guide. In 1989, the OR Society produced an excellent careers guide, illustrating the variety of OR practice. However, the examples of OR work, which form a substantial part of the booklet, describe only the nature of 'the problem', and an outline of the solution method and techniques employed; they say nothing at all about the consulting process which is the foundation for all this work. [However, it is interest to note that the skills 'checklist' on the inside cover of the ORS booklet gives more emphasis to consultancy skills than to technical abilities.] It is not immediately obvious how consultancy issues can be described in such concise terms, without recourse to trite adages about 'relating to clients'. However, if OR education is to be built on a consultancy basis, this process must include careers booklets.

12.3 Reflections

In this closing section, I shall summarise my reflections upon the way in which I have conducted this project. I consider such reflection to be an integral part of research training, and of a 'hermeneutic' approach to social science.

In general, I have not maintained adequate *control* over the research project. This is mainly due to a lack of *rigor* in the process of study. In other contexts, I expect to be able to carry out small 'projects' properly and efficiently by relying on a very good memory; I have learnt that this is totally inappropriate to a major research project. Specific areas, where improvements could have been made, are as follows:

1 Administration - Only at the very end of the project have I introduced a comprehensive system for filing and cataloguing literature and notes. This would have been a great advantage, had it been introduced earlier.

2 Data Analysis - I could have made more efficient use of (and more frequent reference to) interview data if I had invested time in a method of copying, cutting and pasting notes in order to analyse specific issues discussed during interviews. Although my 'colour and wallpaper' method was very useful, it required very concise notes; it could have been used in conjunction with 'copy, cut & paste' to aid more thorough analysis.

3 Interview Structure - It is possible that more tightly structured interviews may have made analysis easier. However, I think this is probably a vain hope; I could not have collected all the data that I did without being very flexible, allowing conversations to develop 'naturally', and discreetly re-asking questions in slightly different ways.

4 Writing Up - Of the social science PhD, John Ziman (1987) remarks that "there is a strong tendency to work on beyond the point in the third year when all the effort should be going to writing it up". My chosen research topic is very broad - the *whole* of OR, I have read widely, and the data I have collected is both rich and subtle. Consequently, during the latter half of the project, the prospect of articulating and explaining my findings has seemed quite awesome. Ultimately, I have taken Ziman's advice, "effectively redefining the project so that it turns out to have been 'do-able' within the time available".

With hindsight, I recognise that greater 'collegiality' would also have helped the research process. Young (1987) defines "collegiality" as "the sense in which research students and relevant faculty members are engaged in a joint research endeavour" which "can go far to alleviate their corrosive isolation". When I joined the department of Applied Statistics and Operational Research at Sheffield City Polytechnic, I was the only full-time research student. Most

of the departmental staff took no active interest in my research. I now understand that this had more to do with poor communication, and general 'fragmentation' within the department, than with actual *un*interest. There was no 'professional' or social forum for research students at the Polytechnic. Informal 'networking' of researchers during 1989/90 revealed considerable frustration, and feelings of isolation, repression and even depression amongst researchers. The Research Office now runs a Research Training Programme for all research students. I regret that I did not make more positive moves to inform other members of staff, and other researchers, and to involve them in my work. This would have encouraged cross-fertilisation of ideas, and brought social and emotional benefits.

Despite these shortcomings, I hope that I have succeeded in being, in Argyris and Schon's (1974) words, some sort of "bridgehead" between the practicing and academic sectors of the OR community.

12.3.1 The impact of fundamental assumptions

In section 2.2, I outlined the basic assumptions which have provided the foundation of my research methodology. I emphasised that I was concerned to defend the *validity* of Christianity as a basis for social science, rather than the uniqueness or peculiarity of it. Nevertheless, in view of the fact that other researchers may have adopted different perspectives, it may be worth speculating on the impact that different stances would have had on the outcome of the research. Two initial observations can be made:

Firstly, it does not appear to be normal practice for scientists to 'declare their (metaphysical) interests' in presenting their research. Consequently, it is difficult for me to be sure of my ground in considering alternative

perspectives; I am loath to offend my peers by caricaturing their beliefs.

Secondly, "alternative perspectives" do not necessarily involve wholesale acceptance or rejection of the metaphysical, human and social aspects of the Christian stance outlined in section 2.2; rather, a plethora of religious and atheist stances converge and diverge at various points. For instance, humanism and existentialism originally asserted the importance of human values and personal experience, respectively, within a religious framework. Modern humanism incorporates many beliefs and values from Judeo-Christian traditions, although its metaphysical basis is undeclared and usually unexamined; Sartre (1948) considered God's supposed non-existence to be "very embarrassing" since value and purpose might be lost too. Conversely, humanist thought undoubtedly influences Christian tradition.

A hypothetical extreme existentialist's stance would probably be inadequate to support a concerted research effort, since the continuing historical development of OR as a 'profession' or discipline, and the possibility of making professional practice 'better', in some objective sense, would not be major concerns. However, it is probably wise to compare my Christian perspective with alternatives which *actually are* adopted by contemporary researchers in the OR/management sciences field.

The work of Rosenhead and Thunhurst (1982) and Vidal et al (1989) demonstrate assessments of OR *per se* which rest on particular socio-political assumptions. Rosenhead and Thunhurst were concerned, in their "materialist analysis", to view OR "relative to the 'laws of motion' of the economic system which fostered it" (Rosenhead and Thunhurst, 1982). They argue that OR has adopted ideas (such as optimisation) which accord with the interests of those who control capital. If this perspective was adopted in empirical study of OR, then practitioners would be criticised for continuing in the

'service' of management, and for not offering "self-management science" (Rosenhead and Thunhurst, after Hales, 1978) to non-managers. They would be criticised for not actively joining with "workers" in their "struggle" against "management" (Rosenhead and Thunhurst). It is clear from Rosenhead and Thunhurst's (1982) paper that "exploitation" and "exclusion of the mass of people from power" are assumed to be *bad*, whilst "popular democracy" and "benefits to the workforce" are *good*, though the basis of these value judgments is not disclosed. These values are similar to Christian values except that hierarchy and asymmetrical authority relations are not *in themselves* considered to be wrong, in a Christian framework.

Vidal et al (1989) openly declare "we were looking for an alternative practice of OR with social responsibility". As in Rosenhead and Thunhurst's work, "domination" is taken to be *bad*, whilst an "adequate standard of living" plus considerable autonomy and freedom for "the majority of the population" (Vidal et al, 1989) are taken to be *good*. Vidal's "new conception" of OR is of a *participative* process whereby those who are affected by decisions are involved in decision making. From a Christian standpoint, ('democratic') participation is not regarded as a major concern (though the abuse of power certainly is). Although OR practitioners have authority to influence decision makers in their organisations, they do not have the authority to *make* fundamental changes to the prevailing authority relations.

As Rosenhead (1989c) has pointed out, ORers who adopt politically *right*-wing perspectives have little to gain from critical assessment of their subject, since they are likely to benefit from the status quo. When Rosenhead and Thunhurst's paper was published, the ORS Journal's editor stated "we have edited more drastically than usual" to remove "political overtones" (Rosenhead and Thunhurst, 1982). A similar editing policy was applied to Sagasti's (1976) paper. Consequently, records of alternative socio-political perspectives are scarce.

Checkland has offered a number of critical assessments of OR (eg Checkland, 1983a, 1985). Although he denies *any* metaphysical basis for his assessments (Checkland, 1992, also appendix D), he insists upon the adoption of a "systemic" methodology for problem handling. [This is, presumably, based on *some* assumptions about the nature of the world.] It would be possible to utilise this approach in empirical study of OR practice and methodology. A Christian researcher has, however, no particular allegiance to 'systems' concepts, preferring to focus on individual persons, their behaviour, intentions and thoughts. Systems ideas could, no doubt, be *applied* to the subject but would, in my opinion, provide an unnecessarily cumbersome framework with no obvious benefits. However, the pyramidal model or OR (which was introduced in chapter 3 of this thesis) is an example of *ad hoc* utilisation of systems ideas. Conway and Holland's use of the 'life-cycle' concept is another example of the import of organismic metaphors into empirical study of OR.

Checkland's own 'soft' systems methodology represents a *social* process, in which systems models are used within a debate. Applied to OR practice, such an action-research process would involve engaging members of the OR community in the re-creation of a practice consistent with one or more 'root definitions' of operational research. This is an attractive idea, which stands in contrast to another *type* of research process whereby researchers conduct individual, self-contained, analyses which are *later* subjected to publication and criticism. [In these terms, my research may be viewed as a prolonged contribution to debate, in which a particular root definition of OR (as a consultancy activity) is adopted.]

However, the adoption of a softer, more interactive, approach would immediately raise questions about who, if anyone, has the *authority* to define OR or to enter into debate about OR's

nature and practice. Another example of a 'soft' approach is espoused by Eden, Jones and Sims (1979): here, 'reality' is established by consensus, and "value" is a function of a person's behaviour. It is intriguing that Checkland (1983a) and Eden and Sims (1979) have been able to make confident assertions about the way OR 'really' *is*. In this way, their approach to describing and assessing OR practice and methodology *per se* do not seem to reflect the 'multiple realities' assumptions that they have claimed, any more than my research does. It seems likely that assertions of pluralism are largely rhetorical - serving to emphasise that different interpretations can be made of a single event, and that there is no easy way of establishing who, if anyone, is *right*.

I have argued that science is a social process, and I expect my description and assessment of OR, and the 'root definition' from which it proceeds, to be criticised within the OR community. However, I have also argued that 'scientific knowledge' (or, for that matter, any other form of knowledge) is not the same as *truth*; that truth may not be *established*, through social processes, but that researchers may *jointly approach* truth through experience, observation, interpretation, reflection and critical debate.

In summary, alternative metaphysical bases for social science are rarely made explicit, although some basic beliefs and values can be inferred from scientific papers and other expressions of scientific work. The two most common alternative streams of thought seem to be:

- *Humanism* - in which *some* value judgments are made which are broadly consistent with Christian ethics and may be derived from them. Significant points of departure concern assumptions about the value of certain social and economic structures;

- *Pluralism* - in which a researcher's hope of discovering truth is undermined. Moreover, no basis is declared for value judgments. Proponents of a pluralist stance do not usually, however, refrain from making assertions about the (objective) nature of reality.

Reflection upon one's assumptions, about 'the way the world is', is an important part of the development of research methodology. It is, therefore, an important part of the process of research training. I have argued, in chapter 2, that my work is consistent with the faith that I profess; in the above discussion, I have speculated about the ways in which other researchers might have approached the same ('given') subject matter. It might be expected that researchers with different beliefs would approach their work in different ways. This expectation is, however, based on the following assumptions:

(a) That the practical implications of different metaphysical stances proceed *'in parallel'* (i.e. without converging or diverging) from these stances. I have argued, above, that this is not necessarily the case;

(b) That 'different' research methodologies proceed *rationally* from the metaphysical beliefs which different researchers' profess. I am not convinced that this is true, though this is hard to assess because of the general lack of discussion about the bases of scientists' belief systems. I believe it is my responsibility to reflect upon, and to argue for, my own rationality. In doing so, I hope that I might encourage other researchers to do likewise.

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APPENDIX A

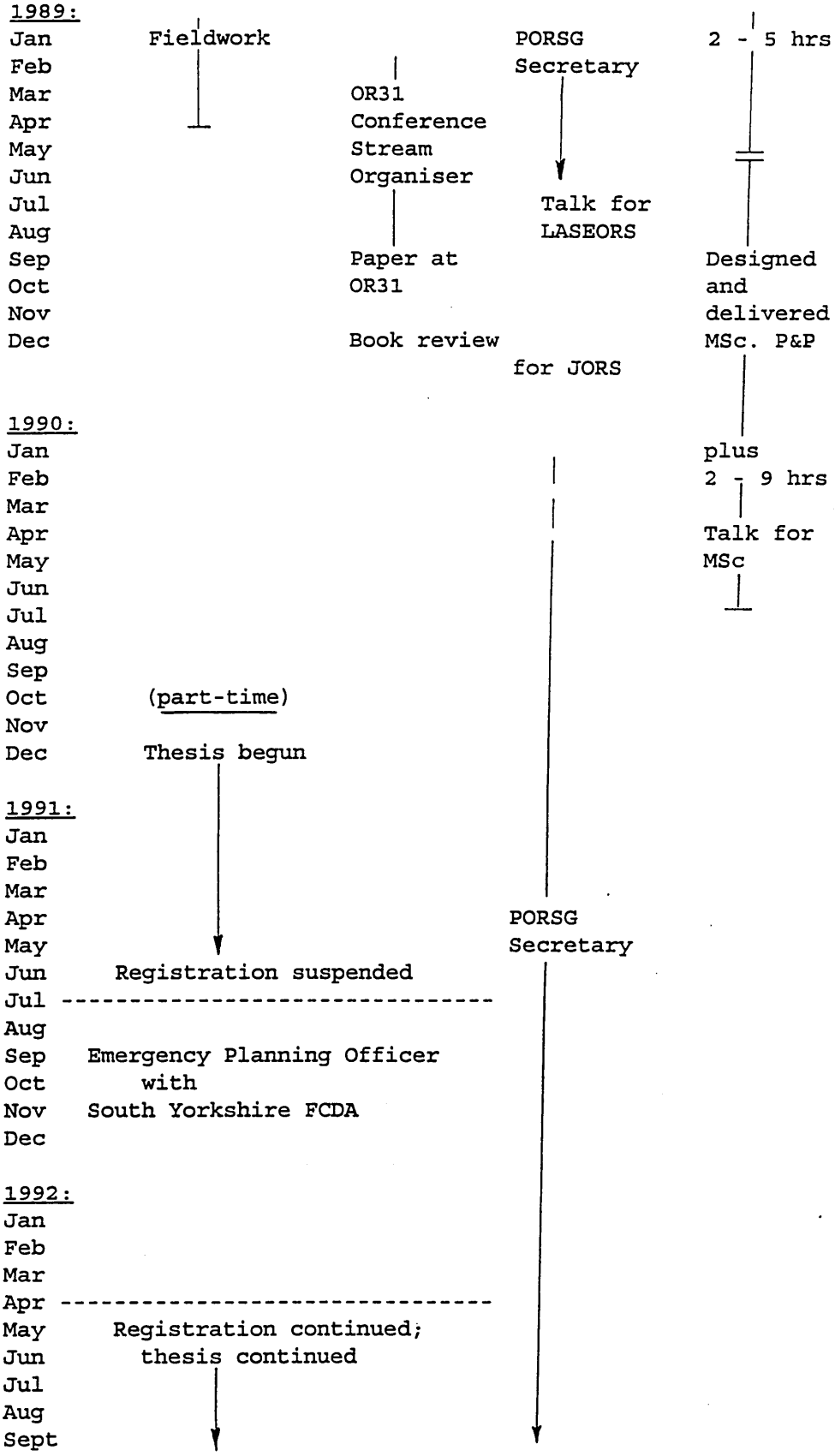
RESEARCH PROJECT CALENDAR

This chart shows how the research has been carried out, in either full-time or part-time mode, between 1987 and 1992.

It also shows my involvement, in various ways, with the OR Society. This involvement has facilitated contact with prospective interviewees. It has also enabled me to interact with researchers in related fields, and with other people with similar interests. It has provided opportunities, mostly through conferences and other events, for some of my ideas to be tested against other ORers' experiences, and opportunities for me to promote further and wider study of OR practice.

The right-hand column of the chart shows my teaching commitments at Sheffield Polytechnic. In most cases, these commitments were distractions from the research. However, the "Practice and Process" module of the MSc in OR (by distance-learning) is directly related to this research. Its development will be described and explained in chapter 11 of this thesis.

Date	Research	OR Society		Teaching
1987:				
Jan	Began research			
Feb	(full-time)			
Mar				6 hrs
Apr				
May	Pilot			
Jun	study			
Jul				
Ayg				
Sep	Proposal	OR30		
Oct	accepted	Conference		
Nov		Committee		
Dec		and Stream		3 hrs
			Organiser	
1988:				
Jan				
Feb				
Mar			Paper at YOR	
Apr			Conference	
May	Transfer			
Jun	Report			
Jul	written			
Aug				
Sep		OR30 in		
Oct		Sheffield	Article for	
Nov			OR Insight	
Dec			(Appendix C)	


1989:
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Fieldwork
OR31
Conference
Stream
Organiser
Paper at
OR31
Book review
PORSG
Secretary
Talk for
LASEORS
for JORS
2 - 5 hrs
Designed
and
delivered
MSc. P&P
plus
2 - 9 hrs
Talk for
MSc
1990:
(part-time)
Thesis begun
1991:
Registration suspended
Emergency Planning Officer
with
South Yorkshire FCDA
PORSG
Secretary
1992:
Registration continued;
thesis continued

Abbreviations and Notes:

ORS	Operational Research Society
OR30/OR31	OR Society annual conferences
YOR	OR Society Young OR conference
PORSG	ORS Process of OR study Group
OR Insight	ORS publication
JORS	Journal of OR Society
MSc	Sheffield City Polytechnic MSc in OR
MSc. P&P	MSc module: OR Practice and Process

APPENDIX B

ANALYSIS OF REPRESENTATION

The results of my survey, concerning eleven easily measurable - 'demographic' - characteristics, are presented here in detail. These results are compared with other recent, but much larger surveys. I shall comment on how well the population of OR practitioners appears to be represented in my sample.

The main large-scale survey to which a shall refer is that carried out by M P Carter of North Staffordshire Polytechnic. Carter surveyed the entire population of the OR Society, by postal questionnaire, and received 1436 replies, representing a 42% response rate. This population includes full-time OR practitioners, academics in OR, and many others who either do, use, or are interested in OR. Consequently, the results that I quote here do not necessarily apply to the population of OR *practitioners*. Where it is possible, I shall specify details of practitioners, or make approximations based on Carter's findings. Carter's results have been published in Carter (1987 and 1988) and in ORS (1986).

The OR Society's Commission on the future practice of OR also surveyed 400 OR groups (or other groups containing OR people). It received 116 replies from groups claiming to do OR. Whilst this sample comprises people who actually *do* OR, the Commission considered that "there are more people practising OR outside or similarly designated groups than inside them" ORS (1986).

Unless stated otherwise, the percentage figures refer to the proportion of OR *practitioners*, rather than proportion of groups etc.

1. Job title

	ORS[1]	(Five)[2]	(Seven)[2]
OR Manager	14 %	0 %	14 %
Senior OR Analyst/ officer etc	18 %	40 %	29 %
OR Analyst etc	20 %	40 %	29 %
OR Consultant (external)	9 %	0 %	14 %
Planning/Stats/ Man. Services etc	20 %	20 %	14 %
Systems/Computing	18 %	0 %	0 %

Notes:

1 An approximation, based on ORS (1986), by excluding lecturers, students, managers with an interest in OR, and "others", and re-classifying some *internal* "consultants" as "analysts".

2 The sample of seven OR practitioners included one OR manager, and one external consultant who, by his own admission, does a very different kind of work from most other ORers. These two people were not removed from the sample. On the contrary, their experiences and views have been *particularly* helpful in making sense of the survey data. However, as with the manager who was removed from the survey, it is recognised that these two people's roles could not be as *fully* and *easily* described (with the chosen framework) as the others'. Throughout this analysis, I shall specify my findings based on both the full sample of seven practitioners, and also based on just the five in-house practitioners.

Comments:

The sample, of seven, seems to be fairly representative of OR practitioners, although there is an under-representation of those who do OR but are not designated full-time OR practitioners - particularly those in systems/computing. To some extent, this is regrettable. However, I have chosen (see chapter 2) to concentrate on OR workers who willingly bear the name "OR". As I have noted, it was the people with only a marginal association with OR who declined to be interviewed.

The five OR workers, who are neither managers nor consultants, are drawn from categories which total approximately 60 % of the practicing OR community (based on Carter's survey, ORS, 1986).

2. Group title

	ORS[1]	(Five)[2]	(Seven)[2]
OR Department etc	30 %	100 %	86 %
OR Consultant	10 %	0 %	14 %
Systems etc	25 %	0 %	0 %
Planning/Man. Serv.	25 %	0 %	0 %
Others	10 %	0 %	0 %

Notes:

1 Approximation, see 1., above.

2 Two interviewees belong to small OR groups which are part of a broader department. In total, 29 % of the OR practitioners work within a "Planning/Management Services" group.

Comments:

Again, this sample appears to over-represent those whose work is *overtly* OR. However, note 2. suggests that OR work in groups with a broader remit *is* represented.

3. Group size

	ORS	ORS[1]	(Five)	(Seven)
0 - 1	23 %	1 %	0 %	14 %
2 - 5	27 %	10 %	40 %	29 %
6 - 10	22 %	20 %	20 %	14 %
11 - 20	18 %	20 %	0 %	0 %
21 - 50	8 %	30 %	40 %	43 %
> 50[2]	3 %	20 %	0 %	0 %
Mean	10	30	15	15
Median	6	20	10	10

Notes:

1 Approximation based on the ORS Commission's survey of OR *groups* which recorded % of *groups*; here I have recorded % of *practitioners* in groups of particular sizes. Note also that the commission measured 'number of OR workers in group' (including non-OR groups), rather than 'size of OR group'.

2 ORS (1986) reported 3 groups containing over 50 OR practitioners. This may include some organisations' total number of OR workers who are separated, often geographically, into smaller groups. In this case, one practitioner in my sample would be re-classified from "21 - 50" to "> 50", thus raising the mean group size to about 25.

Comments:

In view of the provisos noted above, it is difficult to draw any firm conclusions about representation in terms of group size. However, it is clear that groups of varying sizes *are* represented. The mean and median practitioner's group sizes are smaller than those calculated from ORS (1986), although point 2., above, should be considered.

Perhaps surprisingly, OR *workers* in larger groups may be under-represented here. However, larger *groups*, themselves, may actually be *over*-represented. As there are undoubtedly *some* similarities between the practices of different ORers within the same group, the distribution of groups sizes in this sample may actually achieve a sensible compromise between the two kinds of representation.

4. Sex of practitioner

	ORS	(Five)	(Seven)
Male	90 %	100 %	100 %
Female	10 %	0 %	0 %

Comments:

The sample reflects the fact that a large majority of ORers are men. It is difficult to represent the female minority in such a small sample; one woman was invited to be interviewed, but she declined.

5. Age of practitioner

	ORS	Carter[2]	(Five)	(Seven)
Mean (years)[1]	37	31	32	37
Standard dev.	10	na	7	11

Notes:

1 Carter (1987) notes that the distribution is skewed; mean values may be falsely high.

2 Carter (1988) cross-tabulates age with group title (see 2.). This column shows average age of members of an OR department.

Comments:

The sample appears to give an accurate representation of the OR community, by age. The group of five OR workers (all members of OR departments) accurately represents OR dept. members. However, considering note 1., above, as the sample ages are symmetrical, there may be a slight over-representation of older practitioners. Carter (1987) gives the average age of female ORers as 29 years - see 4., above.

6. OR experience of practitioner

	Carter (87)[1]	Carter (88)	(Five)	(Seven)
Mean (years)	11	7	10	14
Standard dev.	7.5	na	7.5	11

Note:

1 This figure includes lecturers in OR, as well as managers with an interest in OR. It is not obvious how these figures relate to the experience of OR practitioners themselves.

Comments:

The sample appears to give a reasonable representation of the experience of ORers, though it may give a slight over-representation of experienced practitioners. Carter (1987) notes that the distribution is skewed; the inclusion of a man with 21 years experience in OR has a considerable effect on the mean value.

7. Practitioners' qualifications (and % OR-related)

	Carter (87)	Carter (88)	(Five)	(Seven)
Diploma	12% (47)	6% (75)	0%	0%
First degree	89% (28)	94% (26)	100% (20)	100% (14)
Masters deg.	58% (81)	58% (90)	20% (100)	28% (50)
Doctorate	18% (50)	10% (37)	0%	14% (0)

Comments:

The sample gives an under-representation of practitioners who have used an MSc in OR as a springboard into the profession. These tend to be young practitioners (see 5., 6., above).

8. Business area of organisation

	Carter[1]	(Five)	(Seven)
Nation'd Ind.[2]	16 %	20 %	14 %
Government	16 %	20 %	29 %
Engineering	11 %	0 %	0 %
Computing	9 %	0 %	0 %
Finance	8 %	20 %	14 %
Consulting	8 %	0 %	14 %
Manufacture	8 %	0 %	0 %
Chemicals/Oil[2]	6 %	20 %	14 %
Food[3]	5 %	20 %	14 %
Others[2]	13 %	0 %	0 %

Carter (1987) reports 45 % of ORS members (including academics) in the "public sector". The figure for this sample is 40 - 60 %, depending on definitions.

Notes:

1. Approximation, based on ORS (1986) and Carter (1987), by removing OR academics.
2. This figure has reduced since Carter's survey in 1985, owing to privatisation. In particular, some would be re-classified as chemicals/oil, or as 'others'.
3. ORS (1986) reports 18 % of OR *groups* are in the food industry, suggesting a large number of small groups, or perhaps just an unusually high response rate.

Comments:

The sample includes practitioners from most of the main business areas represented in the OR community. The exceptions are computing (see 1., above), plus engineering and manufacturing industries.

9. Organisations' number of employees

	ORS	Carter	(Five)	(Seven)
0 - 100	10 %	1 %	0 %	14 %
100 - 1,000	21 %	5 %	0 %	0 %
1000 - 10,000	30 %	21 %	20 %	14 %
10000 - 50,000	19 %	27 %	20 %	14 %
> 50,000	20 %	46 %	60 %	57 %

Comments:

Carter's (1988) figures are for members of OR departments. He remarks that "OR departments exist mainly in the larger organisation" and that "respondents in planning and management services also seem to operate in the larger organisation". The sample, particularly the group of five in-house practitioners, gives an accurate representation of OR departments' organisations.

10. Organisation's location

	ORS	(Five)	(Seven)
London	35 %	20 %	29 %
South of England	27 %	0 %	0 %
Midlands	14 %	0 %	14 %
North of England	17 %	80 %	57 %
Rest of GB	8 %	0 %	0 %

Comments:

There is a systematic and deliberate bias towards the north of England, for convenience (see chapter 2). Practitioners from London were selected for the sample in order to represent the particular business areas and business climate of the capital city.

11. Group age

On average, the OR groups in the sample have been in existence for about 20 years, in various forms and under various titles. No comparative figures are available from Carter or the ORS Commission.

APPENDIX C

"WHERE ANGELS FEAR TO TREAD"

OR Insight Vol. 2 No. 2 April–June 1989

Where angels fear to tread

Effective OR requires simultaneous management of technology and client relationships

Graham Jones

OR involves the development and use of technology within a social context. GRAHAM JONES describes some aspects of managing relationships with clients and technology. A simple framework is suggested to aid discussion of OR practice.

In everyday conversation, most OR practitioners recognize the importance of developing and maintaining relationships with potential clients or sponsors, and with other people who have stakes in the outcome of OR work. In view of this, it is surprising how little attention is paid to the deliberate study of those activities, and how rarely they are cited in accounts of OR work (see Bryant, 1988). In this article, I shall try to draw attention to some aspects of such relationships and their relevance to carrying out OR project work.

Managing relationships

At the simplest level, relationships are necessary in order to "get work". Furthermore, close relationships allow clients or sponsors a better understanding of the domain and potential of OR and of the language and style of the local OR group. Although consultancy intervention is often portrayed in terms of a temporary coalition formed to carry out a specific task, the continuity of OR-client relationships is important, as many in-house groups will be aware (see also Tomlinson, 1974 – the "partnership" principle). Continuity allows OR to establish immediate involvement with issues as they arise, rather than being called in to "clear up a few facts". Continuity also allows feedback and negotiation, both of the project specification (Norman, 1988) and of the definition of the problem itself. Continuity thus helps OR to be relevant and creative.

How then, on a practical level, can relationships be developed and maintained? The most obvious source of new clients is "the grapevine", through which successful, (and unsuccessful) projects are reported, but OR groups may supplement the grapevine with publicity and public relations activities. Technical features of OR projects may be communicated via bulletins and magazines, while invitations to attend demonstrations and to sponsor short projects allow potential clients preliminary interaction with OR people themselves. However brief this communication, it is essential that individual OR practitioners project an image which the OR group would consider to be appropriate to its role – invariably an image of disinterested intelligence. Continuity of relationships can be enhanced by geographical convenience or organizational structure, though these factors alone are insufficient. An ideal basis for OR work would be an intimate, flowing relationship which requires not only continuity of contact but also genuine mutual understanding (in the sense of Churchman and Schainblatt, 1965).

Managing diversity

Things start to get a bit more complicated when we recognise that OR groups and, usually, individual practitioners are involved with a variety of different clients in order to increase the input of project work, to enable a balanced portfolio of projects to be maintained, and to safeguard against changes in (client) personnel.

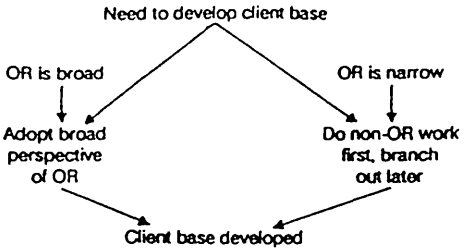
With this variety comes diversity in personality, managerial style, decision-making style and perception of OR. Differences in managerial style may imply different approaches to handling problems – some managers may want OR people to "tinker with" their problems, others to "hit them with a brick". Differences in decision-making style have implications for the design of decision aids (de Waele, 1978) which are neglected in attempts to sell standard software. Differences in perception of OR are often treated as differences between enlightenment and ignorance (though the latter may be the case), whereas the adoption of a repertoire of roles and images under the OR umbrella may help to broaden the client base.

In order to manage a relationship with a single client, OR practitioners require interpersonal skills and communication skills (both in presentation and in listening). In order to manage client diversity, they need to be perceptive and adaptive, and to be aware of a breadth of approaches within OR.

This relationship-based perspective of OR draws attention to the self-perpetuation of an OR group's image via client expectations. As Norman (1988) points out, agreement to take on work which does not embody an OR approach in order to secure projects, may lead to a form of specialization which is undesirable in the short term. However, Norman maintains that there is an opportunity to branch out later, thus securing the long-term future. It is worth noting that, as in the case of an estate agent advertising a house as presenting an "ideal opportunity for further improvements", an opportunity is

sometimes a problem in disguise. Realization of the breadth of OR can help to reduce the need for this problematic practice (see Figure 1).

Figure 1: Alternative perspectives of the development of a client base

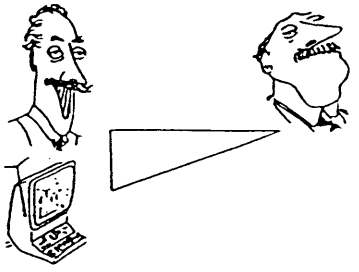


Managing technology

In principle, OR-client relationships would be fairly easy to manage were it not for the presence of an intruder – technology, in the shape of numeric, diagrammatic and computer-based facilities. Technology is not usually viewed by the OR community as an intruder, rather as a badge of office, trump card, fondest creation or even *raison de faire*. Nevertheless, skilful management of the introduction and use of technology within OR-client relationships is required.

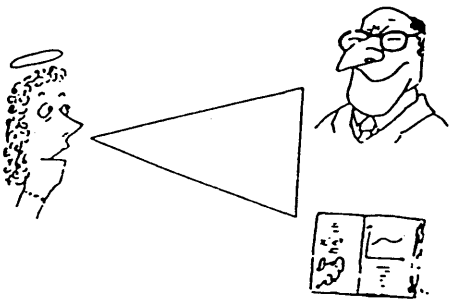
Traditionally, OR people are good at using technology for data handling and analysis, and for presentation of information. However, to preserve continuity, the use of technology during other activities within a project, such as inquiry, problem formulation, negotiation and generation of commitment to action, must also be managed carefully. Most projects begin with a period of inquiry into a problematic situation, which is usually approached with an implicit checklist. The first explicit use of technology within this episode of a consultant-client relationship may well be the introduction of a computer model. Little (1970) recommends that "*if we want a manager to use a model, we should make it his, an extension of his ability to think about and analyse his operation*". To achieve this, we must be careful to avoid the Blue Peter syndrome (i.e. "*here's one I made earlier*"), which can be a turn-off (see Figure 2).

Figure 2: Peter Blue unveils a model he made earlier



Another common use of OR technology is as a basis for discussion between client and consultant, or between two or more members of a client group. Technological advances have allowed the luxury of problem-reformulation based on computer models (see Tobin, 1976), but it seems that OR consultants' approach to this activity is largely *ad hoc* – "*I showed him the model and he pointed to it and said, 'that's wrong!'*". Negotiation of appropriate action based on a number of alternatives is often treated with a detached attitude by OR practitioners – "*I gave them the facts and let them get on with it*" (Figure 3). Some attempts have been made to develop technology which can help to support the consultant and to guide the client(s) throughout the OR process, though these have been mostly in the area of group decision support (e.g. Phillips, 1987).

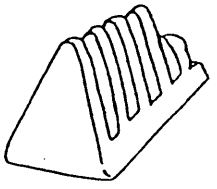
Figure 3: Our Lady of the Perfect Perception attempts divine intervention



A triangular relationship

Many of the points made in this article may seem trivial. However, acquisition of the skills required to handle the triangular relationship involving OR practitioner, client and technology which underpins much of OR practice, is far from trivial. Consequently, reflection upon and management of the continuity and intimacy of this relationship can contribute to effective practice. In recognition of the need to manage a portfolio of projects, and invariably a portfolio of relationships, it may help to base discussion of OR practice on the shape of a well-known bar of chocolate.

Figure 4: A well-known bar of chocolate



This depiction of OR practice is, of course, a simplification; for one thing, it takes no account of changing relationships during the course of a project. Furthermore, the chocolate bar model needs to be adapted to show that relationships necessarily vary from project to project.

Think of this article as a discussion document!

For the interested reader

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APPENDIX D

"O.R. PRACTICE, SYSTEMS METHODOLOGIES, AND THE NEED TO DO BETTER"

I have enjoyed the recent exchanges between John Mingers and Mike Jackson through the "viewpoints" section of the Journal. I would like to make a contribution to their debate, mainly because I am concerned about the way in which OR practice is portrayed by advocates of systems methodologies. I shall begin by offering my assessment of the nature of problem contexts, as defined in Jackson and Keys' original paper[1]. In doing so, I hope that I shall not cause Mike Jackson any further anguish. In a second section, I shall discuss, more generally, the assumptions which seem to lie behind systems methodologies. I shall refer mainly to the Mingers/Jackson debate, and also to Peter Checkland's recent paper[2]. Finally, I shall address the categorisation of OR in the system of systems methodologies. I shall argue that systems literature does not always do justice either to the practice of OR, or to its methodological foundations.

What did Jackson and Keys say about 'problem contexts'?

There is considerable evidence, from Jackson and Keys' original paper[1], that problem contexts were thought to exist objectively. For instance, they referred to "*real-world* problem *contexts*", and to"the nature of *the system(s) in which the problem is located*" (emphases added). However, the *identification and classification* of problem contexts are recognised to be more problematic. On the one hand, Jackson and Keys referred to "contexts in which problems *are found*", suggesting that problems can be discovered, and encountered by (eg) consultants, in their objectively existing contexts. Similarly, Jackson[3] refers to "the problem context with which he [the consultant] is *faced*" (emphases added). Yet it is recognised[1] that "problem contexts in the real world rarely announce their character unambiguously. The way any problem context is perceived is going to depend very much on the individual who is observing it. .. A problem solver's 'W' [weltanschauung] will very largely determine the way he sees and approaches problem contexts". The language used, here, suggests that problem contexts have a true, intrinsic, character, but that this character may be hidden from an observer with a particular (subjective) world-view. The above quotation continues, "..The problem solver needs to stand back and examine problem contexts in the light of different 'W's. Perhaps he can then decide which 'W' seems to capture the essence of the particular problem context he is faced with." Now the observing subject is asked to step outside himself, and

contemplate the very *essence* of the objectively existing context.

The message is already rather confused, though the evidence seems heavier in favour of the 'objective contexts' interpretation. Surely, "the author's [i.e. Jackson's] own views on the matter"[4] are "accurately reported" by means of the above quotations. I believe Mingers[5,6] is entirely justified in his assessment of this aspect of the 'system of systems methodologies' argument.

The nature of assumptions underlying OR and systems methodologies

Jackson has questioned[7] "whether it is possible to arrive at an 'objective' *account* of the nature of any problem situation" (emphasis added), and now argues that it is contradictory to use a taxonomy of methodologies (for *objectively existing* situations) in which a *choice* is offered between 'functionalist' and 'interpretive' approaches. Mingers[5] argues that the whole point of recognising the usefulness of a variety of approaches must be that they are each appropriate for situations which are objectively different.

Jackson[7] objects to "functionalist" uses of the taxonomy, arguing that "any problem-situation can be viewed in variety of ways". However, he also objects to "regulative" approaches, in which "issues such as structural inequality" are ignored. There appears to be a contradiction, here, between preferring an interpretive use of the taxonomy, and yet insisting upon a 'critical interpretation'. Schecter[8] defends Jackson at this point, arguing that "there is no contradiction .. between emancipation and pluralism, because the two are at different logical levels .., pluralism relates to the total structure of the system of systems methodologies, .. while emancipation relates specifically to the emancipatory interest". Mingers[9] then appears to argue the opposite point, stating that critical theory, and critical (in the socio-political, rather than intellectual, sense) intent on the part of a consultant, is "at a meta-level" to the other two types of methodology.

Both of the viewpoints expressed in the paragraph above seem to bring the argument back, full circle, to the original point of departure for soft and critical methodologies: namely, an objection to any suggestion that a consultant can intervene in a situation, claiming a 'higher' (objective) view, and imposing a particular interpretation on the situation. One cannot object to 'unitary' classifications of problem contexts, and to Dando and Bennett's[10] "official" paradigm, without asserting that some other approach is objectively truer, or better, in some sense.

Proponents of 'soft', and of 'critical', approaches within management science have had (and continue to have) a liberating effect on the subject, both intellectually, and in social and political terms. However, at a theoretical level, their work is often self-contradictory and narcissistic because they refuse to yield the trendy-social-science myth that they are not making ideological judgements. The same tendencies are apparent in Checkland's paper[2] which was recently published in this Journal: Checkland asserts that the only possible source of 'systems' ideas "is our perception of the world outside ourselves .. This .., usefully underlines the *groundlessness* of systems thinking: there are no absolutes in our epistemology". He says that "we should carefully avoid .. mere ideological statements and commitments", and that "to pretend that systems ideas entail a particular ideology is absurd". The fact that the words "idea" and "ideology" have the same root seems to have escaped his attention. Checkland states that, at the base of his methodology, is a view of the world as "problematic" - a view in which he makes no assumptions about its nature or form. Nevertheless, he is determined that a "systemic" methodology is appropriate for studying this problematic world. Why should such a methodology be appropriate? Checkland's use of the distinction between ontology and epistemology benefits from closer study:

Despite his determination to avoid ideological statements, Checkland clearly considers it possible to make ontological statements about the world; they simply require "very good supporting evidence to justify them". In the case of systems ideas, Checkland believes that ontological statements could be made by carefully mapping "the concept of wholes onto what we perceive as complex happenings in the real world". He cites *specific* examples, from mature disciplines (namely chemistry and history), where concepts have been either been consciously used as "an epistemological device", or where, *with hindsight*, they can be seen to have been merely that. Firstly, although these examples are helpful for illustrating Checkland's argument, they do not help to overcome the basic problem of moving from epistemological statements to ontological statements - namely that epistemological devices cannot be *so thoroughly* "tested out in the real world against empirical evidence" unless the essence of this evidence can be experienced *objectively*. If this kind of testing is not possible, ontological statements can only be made by *metaphysical judgement* - by a step of faith - by which it is accepted *as given* that certain things *are* (true). Secondly, if concepts need to be treated so carefully, as 'epistemological devices', it is surely wise to avoid basing an entire methodology on a concept which is abstract and unobservable, as is the case with 'systems' approaches. To borrow Mingers' analogy[5], Checkland appears (like Jackson) to be 'riding two horses' - in this case, they are the horse of

'systems ideology' and the horse of 'pluralism' - and to be switching horses in mid-stream.

OR practice, and its characterisation in systems literature

Jackson and Keys' original paper[1] aimed to use the system of systems methodologies to reveal things about certain *methodologies*. This aim is restated by Jackson[7], and by Schecter[8]. One of these methodologies was "Operational Research", and it is stated by Jackson that the authors hoped to *enhance* OR. I would like to comment on the way in which OR has been portrayed and classified in the 'systems methodologies' literature. I will refer to the two dimensions used by Jackson and Keys.

Jackson and Keys define OR to be appropriate to "mechanical-unitary" contexts. They refer to "OR methodology" as "any kind of advice given to analysts about how they should proceed to intervene in the real world". One might expect, therefore, that the classification of OR is empirically based, but instead it appears that "OR" is assumed to be virtually equivalent to "the techniques of classical OR" as listed in textbooks[11,12] published in 1957 and 1968. This 'straw man' view continues through Jackson's later writings and is typical of many writings on 'systems methodologies' which have pervaded the OR world (eg Checkland[13], Keys[14]). I would like to object to this portrayal of OR, particularly on the grounds of the relationship between *methodology* (in the broad sense that Jackson and Keys define it), and *techniques* (in the conventional sense of OR 'modelling' techniques).

"Mechanical/Systemic" systems:

Systems are described[1] in terms of 'systemicity', which encompasses non-observability, non-determinism, dynamics, and prominence of behavioural issues. My main point of contention is that Jackson and Keys assume that operational researchers are in the business of "making models *of* situations" (emphasis added) - "the system is .. represented in a quantitative model". Similarly, Mingers[5] assumes that OR is about "'objectively' modelling the external world". Given this assumption, one could look at OR *techniques*, and infer that OR practitioners believe that situations have a particular structure or nature.

My research suggests that although there may be situations where OR practitioners believe that their models represent the whole problem situation facing them, or their clients, this may not be their usual way of working. The emphasis in OR methodology is *pragmatic*. ORers seek to aid their clients in the process of formulating proposals for action in problematic situations. Computable models and techniques are *instrumental* in the consulting process. There must be

some relationship between the nature of the situation *facing the consultant*, and the nature of the model (otherwise model choice and design would be arbitrary), but this does not imply that the problem context is assumed to be systematised at the same level as models themselves.

Many ORers consider that some aspects of both natural and social reality are objectively systematised, and also that systematic thought processes are advantageous when considering many other aspects of reality. Assumptions of this kind justify their choice of approach to situations, and their use of computable models. ORers would, commonly, recognise situations to have non-observable, non-deterministic, dynamic and behavioural elements. They, and their clients, manage these elements in ways which are less easily articulated (than the ways of managing 'mechanical' parts), and which may be largely ad hoc.

"Unitary/Pluralist/Coercive" decision makers / participants:

Jackson and Keys assume that ORers address (or think they address) 'unitary' situations. This is largely because, as Keys[14] points out, many classical techniques are based on the idea of optimisation, in which a single objective is specified. Firstly, ORers' use of such techniques has declined (see Carter[15], Beasley and Whitchurch[16], Mingers[17], for instance). My research suggests that ORers make considerably more use of 'descriptive', heuristic models (although, as I argued above, models may not "describe" the *whole* of reality). Advances in computer technology have helped here, enabling flexible use of models, and greater control over the process of exploring decision options.

Secondly, it is again important to note that the use of a model in which only one view of a situation is represented does not imply that ORers think that their *is* only one view, or that they don't care about any others. Survival in pluralist and coercive contexts is not a problem unique to management scientists, but is common to every situation in which one person or group has power and/or authority over another. It is easy for academics to say that practitioners are not being "critical" (in the political, rather than intellectual, sense). It is easy for us to hold onto such ideals. However, in our own employment, we are constantly making bargains and compromises between our ideals on the one hand, and feeding and clothing our families on the other. OR practitioners are no different, and we have no right to expect them to be.

In summary, the characterisation of OR as a collection of optimisation techniques, appropriate only to mechanical-unitary contexts, is inaccurate and demeaning. This characterisation contributes to the poverty of many arguments in favour of soft, critical and, in particular,

systems-based alternatives. OR need not accept this consignment to the moral and intellectual low-ground.

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